

**APPENDIX III**

**CLARK COUNTY PROPERTY VALUE REPORT ON THE EFFECTS  
OF DOE'S PROPOSAL TO SHIP HIGH-LEVEL WASTE  
TO A REPOSITORY AT YUCCA MOUNTAIN**



**FINAL**

**CLARK COUNTY PROPERTY VALUE REPORT  
ON THE EFFECTS OF DOE'S PROPOSAL TO SHIP  
HIGH LEVEL NUCLEAR WASTE TO A REPOSITORY  
AT YUCCA MOUNTAIN**



8687 East Via de Ventura Drive  
Suite 211  
Scottsdale, AZ 85258





## **Executive Summary**

Stigma resulting from an amplified perception of risk has been associated with all aspects of nuclear power plant siting and operations, and stigma has been associated with a decline in property values. The United States Department of Energy (DOE) has proposed a massive, first of its kind program to transport High-Level Waste (HLW) from civilian nuclear power plants and the nation's weapons complex through Clark County, Nevada to a repository that will be constructed at Yucca Mountain, Nevada. Virtually all of the HLW resulting from this program will travel through Clark County, Nevada. This study investigates the likelihood and extent of property value diminution that may occur in Clark County, Nevada that is directly attributable to this program.

In order to evaluate the range of potential property value effects that may result from the transportation of HLW, this study analyzes the literature that documents the range and magnitude of impacts that have been demonstrated. The research literature provides insight into the range of negative environmental externalities, such as transmission lines and hazardous waste facilities that result in property value diminution. This study also details a scenario-based survey of Clark County real estate appraisers and lenders for residential, commercial, and industrial property; and reports on a survey of Clark County residents. The findings from these investigations are compared and evaluated in order to establish a credible framework of the potential property value effects that may be experienced within Clark County, if the DOE proceeds with its plans.

The research findings indicate that Clark County will likely experience assessed property value diminution ranging from \$75.2 million to \$526.5 million for three types of properties – residential, commercial, and industrial. Within this range, the projection

depends on the route selected and whether the shipment campaign proceeds without incident or whether an incident occurs but does not result in any release of radioactive material. Thus, this projection is based on only a limited number of land uses. For example, it does not include casinos, hotels, shopping centers, or a myriad of other land uses that still need to be examined. Further, although this report provides a first estimation of the level of impact that could occur in the event of a serious accident, which results with a release of radioactive material, they are not included in the range of diminution reported above.

## TABLE OF CONTENTS

	Page
<b>CHAPTER 1 INTRODUCTION.....</b>	<b>1</b>
1.1 PURPOSE AND UTILITY OF THE STUDY .....	1
1.2 BACKGROUND AND SETTING.....	6
1.3 CONCEPTS AND DEFINITIONS .....	8
1.4 DELIMITATIONS AND LIMITATIONS OF THE STUDY .....	9
<b>CHAPTER 2 METHODOLOGICAL APPROACH .....</b>	<b>11</b>
2.1 FORECASTING WITH UNCERTAINTY .....	11
2.2 RESEARCH DESIGN.....	11
2.2.1 <i>Analogous Case Experience</i> .....	13
2.2.2 <i>Clark County Residents' Survey</i> .....	14
2.2.3 <i>Real Estate Market Survey</i> .....	15
<b>CHAPTER 3 EXPERIENCE WITH PROPERTY VALUE DIMINUTION RESULTING FROM ADVERSE ENVIRONMENTAL CONDITIONS .....</b>	<b>17</b>
3.1 NATURE OF THE LITERATURE.....	17
3.2 FACTORS INFLUENCING PROPERTY VALUATION DIMINUTION .....	20
3.2.1 <i>Situational Factors Influencing Property Value Diminution</i> .....	20
3.2.1.1 Physical Factors .....	21
3.2.1.1.1 Type of Hazard .....	22
3.2.1.1.2 Factors of Magnitude and Scale .....	23
3.2.1.1.3 Temporal Patterns.....	24
3.2.1.1.4 Distance .....	25
3.2.2 <i>Cognitive Factors Influence on Property Value Diminution</i> .....	27
3.2.2.1 Knowledge.....	28
3.2.2.2 Perception .....	29
3.2.2.3 Values .....	30
3.3 IMPLICATIONS OF THE LITERATURE REVIEW ON CLARK COUNTY PROPERTY VALUES .....	31
<b>4.0 RESIDENTIAL SURVEY RESULTS.....</b>	<b>32</b>
4.1. INTEREST IN RESIDENTIAL PROPERTY OWNERSHIP .....	32
4.2. OPINIONS REGARDING RESIDENTIAL PROPERTY VALUES IN CLARK COUNTY .....	33
4.2.1 <i>Changes in Residential Property Values</i> .....	33
4.2.2 <i>Impact of Various Facilities or Environmental Conditions on Residential Property Values</i> .....	33
4.3 FAMILIARITY WITH USDOE'S REPOSITORY AND TRANSPORTATION PROGRAM.....	35
4.4. PERCEPTIONS OF THE IMPACTS OF NUCLEAR WASTE SHIPMENTS ON PROPERTY VALUES .....	35
4.4.1 <i>Likelihood of Purchasing Residential Property</i> .....	35
4.4.2 <i>Effects on Property Values: Open-ended Responses</i> .....	36

4.4.3 *Direction and Magnitude of Property Value Impacts on Residential Property* 39

<b>5.0 BANKERS AND APPRAISERS SURVEY .....</b>	<b>42</b>
5.1 DEMOGRAPHICS AND EXPERIENCE .....	42
5.2 PROPERTY VALUE IMPACTS BY SCENARIO .....	44
5.2.1 Scenario 1 .....	45
5.2.2. Scenario 2 .....	48
5.2.3 Scenario 3 .....	50
5.3 FINDINGS RELATED TO LENDERS AND APPRAISERS EVALUATIONS UNDER THREE SCENARIOS .....	52
<b>6.0 DISCUSSION OF COMMUNITY IMPACTS.....</b>	<b>55</b>
6.1 RANGE OF POTENTIAL PROPERTY VALUE IMPACTS FOR LAS VEGAS .....	55
6.2 RANGE OF POTENTIAL PROPERTY VALUE IMPACTS FOR NORTH LAS VEGAS .....	58
6.3 RANGE OF POTENTIAL PROPERTY VALUE IMPACTS FOR UNINCORPORATED CLARK COUNTY .....	60
6.4 RANGE OF POTENTIAL PROPERTY VALUE IMPACTS FOR HENDERSON .....	62
6.5 RANGE OF POTENTIAL PROPERTY VALUE IMPACTS FOR MESQUITE.....	63
<b>CHAPTER 7.0 COMPARISON AND EVALUATION OF FINDINGS AND DISCUSSION OF IMPLICATIONS.....</b>	<b>66</b>
7.1 COMPARISON OF FINDINGS .....	66
7.2 EVALUATING THE RESULTS.....	70
7.3 IMPLICATIONS OF THE RESEARCH .....	72
<b>APPENDIX A – CLARK COUNTY RESIDENTIAL SURVEY METHODOLOGY .....</b>	<b>79</b>
<b>APPENDIX B – CLARK COUNTY RESIDENTIAL SURVEY INSTRUMENT ...</b>	<b>81</b>
<b>APPENDIX C – APPRAISERS AND LENDERS SURVEY METHODOLOGY ...</b>	<b>82</b>
<b>APPENDIX D APPRAISERS SURVEY .....</b>	<b>88</b>
<b>APPENDIX E LENDERS SURVEY.....</b>	<b>93</b>
<b>APPENDIX F CLARK COUNTY RESIDENTIAL SURVEY TABLES.....</b>	<b>101</b>
<b>APPENDIX G LENDERS AND APPRAISERS TABLES .....</b>	<b>110</b>

Figure	Page
<b>FIGURE 1 CLARK COUNTY TRANSPORTATION CORRIDORS.....</b>	<b>7</b>
<b>FIGURE 2 MULTI-METHOD RESEARCH DESIGN .....</b>	<b>12</b>
<b>FIGURE 3 MARKETABILITY EFFECTS .....</b>	<b>18</b>
<b>FIGURE 4 INCOME EFFECTS .....</b>	<b>19</b>
<b>FIGURE 5 PROPERTY VALUE DIMINUTION CONCEPTUAL FRAMEWORK .....</b>	<b>19</b>
<b>FIGURE 6 INFLUENCES ON PROPERTY VALUE DIMINUTION.....</b>	<b>20</b>
<b>FIGURE 7 LENDERS AND APPRAISERS EXPERIENCE BY PROPERTY TYPE .....</b>	<b>43</b>

TABLE 1 NUMBER OF HLW TRUCK SHIPMENTS .....	7
TABLE 2 VALUATION METHODS .....	12
TABLE 3 IMPACTS IN AVERAGE DOLLARS AND PERCENTAGES FOR PROPERTIES ONE- MILE AWAY FROM A LANDFILL .....	26
TABLE 4 FREEWAY USED TO SHIP HLW WASTE BY DEMOGRAPHICS .....	35
TABLE 5 LIKELIHOOD OF PURCHASING RESIDENTIAL PROPERTY NEAR A HLW TRANSPORTATION ROUTE IN CLARK COUNTY, NEVADA .....	35
TABLE 6 PERCEPTION OF RESIDENTIAL PROPERTY VALUE IMPACTS LOCATED NEAR SPECIFIC ROUTES IN CLARK COUNTY, NEVADA (NV) VERSUS SANTA FE, NEW MEXICO (NM) .....	37
TABLE 7 PERCEPTIONS OF PROPERTY VALUE IMPACTS ON COMMERCIAL OR BUSINESS PROPERTIES.....	38
TABLE 8 CONDITIONS UNDER WHICH RESIDENTS WOULD CONSIDER PURCHASING RESIDENTIAL PROPERTY NEAR A HIGHWAY TO BE USED FOR THE SHIPMENT OF HLW IN CLARK COUNTY .....	39
TABLE 9 PERCEPTIONS OF DIRECTION OF IMPACT ON PROPERTY VALUES .....	39
TABLE 10 THE AMOUNT OF DIMINUTION IN SELLING PRICE OF RESIDENTIAL PROPERTIES NEAR A HLW SHIPMENT ROUTE COMPARED TO AN IDENTICAL PROPERTY NOT NEAR SUCH A ROUTE.....	40
TABLE 11 APPLICATION OF PROPERTY VALUE SURVEY TO CLARK COUNTY RESIDENTIAL ASSESSED VALUATION .....	41
TABLE 12 SCENARIO 1 MEAN PROPERTY VALUE DIMINUTIONS WITHIN 1 MILE AND AT 1 TO 3 MILES OF THE BELTWAY ROUTE.....	46
TABLE 13 SCENARIO 1 MEAN PROPERTY VALUE DIMINUTION WITHIN 1 MILE AND AT 1 TO 3 MILES OF THE I-15 ROUTE .....	47
TABLE 14 SCENARIO 2 MEAN PROPERTY VALUE DIMINUTIONS WITHIN 1 MILE AND AT 1 TO 3 MILES OF THE BELTWAY ROUTE.....	48
TABLE 15 SCENARIO 2 MEAN PROPERTY VALUE DIMINUTION WITHIN 1 MILE AND AT 1 TO 3 MILES OF THE I-15 ROUTE .....	49
TABLE 16 SCENARIO 3 MEAN PROPERTY VALUE DIMINUTIONS WITHIN 1 MILE AND AT 1 TO 3 MILES OF THE BELTWAY ROUTE.....	50
TABLE 17 SCENARIO 3 MEAN PROPERTY VALUE DIMINUTION WITHIN 1 MILE AND AT 1 TO 3 MILES OF THE I-15 ROUTE .....	51
TABLE 18 PROPERTY VALUE DIMINUTIONS UNDER THREE SCENARIOS WITHIN 3-MILE DISTANCE OF THE PROPOSED BELTWAY ROUTE .....	53
TABLE 19 PROPERTY VALUE DIMINUTIONS UNDER THREE SCENARIOS WITHIN 3-MILES OF THE I-15 SHIPMENT ROUTE, BY PROFESSIONAL GROUP .....	54
TABLE 20 TOTAL PROPERTY VALUE DIMINUTIONS BY ROUTE, PROPERTY TYPE, SCENARIO, AND PROFESSIONAL GROUP FOR LAS VEGAS .....	56
TABLE 21 TOTAL PROPERTY VALUE DIMINUTIONS BY ROUTE, PROPERTY TYPE, SCENARIO, AND PROFESSIONAL GROUP FOR NORTH LAS VEGAS .....	59
TABLE 22 TOTAL PROPERTY VALUE DIMINUTIONS BY ROUTE, PROPERTY TYPE, SCENARIO, AND PROFESSIONAL GROUP FOR UNINCORPORATED CLARK COUNTY.....	61

TABLE 23 TOTAL PROPERTY VALUE DIMINUTIONS BY ROUTE, PROPERTY TYPE, SCENARIO, AND PROFESSIONAL GROUP FOR HENDERSON.....	63
TABLE 24 TOTAL PROPERTY VALUE DIMINUTIONS BY ROUTE, PROPERTY TYPE, SCENARIO, AND PROFESSIONAL GROUP FOR MESQUITE .....	64
TABLE 25 POPULATIONS OF LENDERS AND APPRAISERS.....	85
TABLE 26 RESIDENTIAL PROPERTY OWNERSHIP INTEREST .....	101
TABLE 27 CHANGES IN PRESENT RESIDENTIAL PROPERTY VALUES .....	101
TABLE 28 EFFECTS OF DIFFERENT ENVIRONMENTAL CONDITIONS ON PERCEIVED RESIDENTIAL PROPERTY VALUES CLARK COUNTY, NEVADA (NV) VERSUS SANTA FE, NEW MEXICO (NM) .....	102
TABLE 29 EFFECTS OF DIFFERENT ENVIRONMENTAL CONDITIONS ON DECREASING RESIDENTIAL PROPERTY VALUE .....	102
TABLE 30 NET ENVIRONMENTAL IMPACT INDEX RATINGS CLARK COUNTY, NEVADA (NV) VERSUS SANTA FE, NEW MEXICO (NM) (RANKED IN ORDER FROM POSITIVE TO NEGATIVE).....	102
TABLE 31 CROSS-TABULATION BETWEEN PERSONS BELIEVING PROPERTY VALUES WILL DECLINE AND OTHER EXPLANATORY FACTORS FOR CLARK COUNTY, NEVADA .....	103
TABLE 32 FAMILIARITY WITH THE YUCCA MOUNTAIN PROJECT AND THE USDOE'S PLAN TO SHIP NUCLEAR WASTE THROUGH CLARK COUNTY .....	103
TABLE 33 DISTANCE FROM PROPOSED SHIPMENT ROUTE IN CLARK COUNTY, NEVADA .....	103
TABLE 34 DISTRIBUTIONS OF RESPONDENTS' RESIDENCES BY PROPOSED ROUTES IN CLARK COUNTY, NEVADA.....	104
TABLE 35 SAMPLE DISTRIBUTIONS BY LENGTH OF RESIDENCY IN CLARK COUNTY, NEVADA .....	104
TABLE 36 SAMPLE DISTRIBUTIONS BY AGE.....	105
TABLE 37 SAMPLE DISTRIBUTIONS BY LEVEL OF EDUCATION.....	105
TABLE 38 SAMPLE DISTRIBUTIONS BY RACE/ETHNIC GROUP .....	106
TABLE 39 SAMPLE DISTRIBUTIONS BY HOUSEHOLD INCOME .....	106
TABLE 40 SAMPLE DISTRIBUTIONS BY GENDER.....	107
TABLE 41 SAMPLE DISTRIBUTIONS BY CLARK COUNTY HOMEOWNERSHIP. ....	107
TABLE 42 SAMPLE DISTRIBUTIONS BY CLARK COUNTY, NEVADA RESIDENCY .....	107
TABLE 43 SAMPLE DISTRIBUTIONS BY RESIDENTIAL LOCATIONS .....	108
TABLE 44 SAMPLE DISTRIBUTIONS BY DISTANCE OF ONE TO THREE MILES OF THE PROPOSED TRANSPORTATION ROUTES .....	108
TABLE 45 SAMPLE DISTRIBUTIONS BY DISTANCE FROM PROPOSED HLNW-SNF SHIPMENT ROUTES. ....	108
TABLE 46 PROFESSIONAL EXPERIENCES OF THE LENDERS AND APPRAISERS SURVEYED .....	110
TABLE 47 LENDING TERMS ON ENVIRONMENTALLY CONTAMINATED PROPERTIES.	110





## CHAPTER 1 INTRODUCTION

### 1.1 Purpose and Utility of the Study

Stigma resulting from amplified perception of risk has been associated with all aspects of nuclear energy including property value diminution (Jenkins-Smith 1999). Over the next thirty years, the USDOE proposes to ship 77,000 metric tons of Spent Nuclear Fuel (SNF) and HLW from 72 civilian nuclear reactors and five U.S. weapons facilities to a permanent repository at Yucca Mountain, Nevada. According to the Draft Environmental Impact Statement (DEIS), if the primary mode of transport is truck, most of the HLW will be transported through Clark County, Nevada. HLW has radioactive components that will remain dangerous for over 10,000 years. Given the amplification of risk that has been associated with all things nuclear and the probability of an incident (even an incident with no release of radioactive material), there is a potential that Clark County may experience significant property value diminution over an extended period resulting from the DOE's proposed activities.

The purpose of this study is to provide the first estimation of the range and magnitude of property value impacts that are likely to occur if the DOE proceeds with this project. This study is part of an ongoing effort by the Clark County Department of Comprehensive Planning Nuclear Waste Divisions (NWD) to document potential impacts resulting from the DOE's proposed actions and to inform Clark County decision-makers as to the nature and extent of these potential impacts.

Under provisions of the Nuclear Waste Policy Act (NWPA), as amended, Clark County has been designated as one of ten "affected units of local government" that is likely to be impacted from the DOE's proposed actions. Accordingly, Clark County is

authorized under the NWPAA to monitor the siting process and conduct its own impact studies, and public involvement program. As part of its responsibilities under the NWPAA, the NWD intends to incorporate the findings from this study into a Clark County Yucca Mountain Impact Report in the summer of 2001.

This paper first examines the effects of other adverse environmental conditions on property values, in order to evaluate the likelihood that adverse property value impacts may be experienced because of the DOE's proposed actions. Numerous studies have indicated that a wide range of negative externalities can adversely influence property values. These negative externalities include noxious facilities, noise, and odors among others. Further, many studies has shown that "nuclear" related facilities consistently rank among those considered most deleterious. This body of research is analyzed in order to inform us as to the nature of impacts that have been demonstrated, and the range and magnitude of these impacts.

This study also reviews and summarizes two surveys that were conducted in Clark County related to property values. The first survey describes the perceptions of Clark County residents as to the likely property value impacts resulting from the DOE's proposal to ship HLW through Clark County. The second, a scenario-based survey describes the opinions, perceptions, and beliefs of property value experts, i.e., lenders, and appraisers, as to the impacts that may be experienced under three alternative transportation scenarios. These three studies are compared and the findings are applied to various land uses within Clark County to provide a first estimation of the magnitude of impacts that may be experienced if the DOE proceeds with the Yucca Mountain transportation-shipping program.

Section 2.0 examines the challenges that are associated with estimating property value diminution from nuclear waste and summarizes the methodologies utilized in this study.

Section 3.0 reviews the significant studies that link public perceptions of risk with the effects of property value diminution. These studies explain how factors such as perceptions and distance from the source of the hazard may affect property values. The nature of stigma is described and its significance to property values is discussed. The results of a multitude of studies are compared. While there is limited experience with the actual shipment of nuclear waste, these studies clearly demonstrate that significant property value diminution could result from the DOE's proposal to ship HLW through Clark County.

Section 4.0 of the report describes the results of a survey of Clark County residents' beliefs and perceptions regarding the effects of DOE's proposal to ship HLW through Clark County on property values, especially residential property values. This survey was modeled after an earlier survey of residents of Santa Fe County, New Mexico. That survey examined residents' perceptions of property value impacts resulting from the shipment of transuranic radioactive wastes through Santa Fe, New Mexico to the Waste Isolation Pilot Project (WIPP) in Carlsbad, New Mexico. The Santa Fe survey was later referenced in a judicial decision that resulted in the State of New Mexico having to compensate for stigma-induced property value diminution. The results of the survey of Clark County residents are then applied to the appraised value of residential properties within one mile of the transportation corridor. Appendix A provides the details of the methodology used in the survey of Clark County residents. Appendix B is the survey

instrument used in the residential survey. Appendix F includes tables supporting the findings from the residential survey.

A second survey, the topic of sections 5.0 and 6.0 examines the perceptions of property value impacts of two professional groups in Clark County who have extensive experience evaluating property values and change resulting from environmental events. Section 5.0 of the report describes the lenders' and appraisers' experience with contaminated property, and documents the level of property value diminution that these experts believe may result for three types of properties under three different transportation scenarios. The rates of diminution identified by these experts then are applied to the appraised property values along the entire length of the two alternative transportation routes within Clark County that could be used by the DOE.

One of the routes described as the I-15 alternative, involves the trucks carrying HLW entering Clark County from both the North and the South. The trucks proceed on I-15 until they reach the intersection of US 95 where the trucks would exit I-15 and take US 95 out of Clark County toward Yucca Mountain. The second route, described as the Beltway or outer loop alternative, would also have the trucks entering Clark County from both the North and South using I-15. When the trucks carrying HLW from the south reach the Western Beltway, they would exit I-15, take the Western Beltway to the Northern Beltway, and then turn north onto US 95 toward Yucca Mountain. The trucks carrying HLW from the north along the Beltway Route (also referred to as the Outer Loop Route) would follow I-15 south to the Northern Beltway. At that point, they would exit I-15, follow the Northern Beltway west to the US 95 exit, and then go north on US 95 toward Yucca Mountain.

The three scenarios used in the lenders and appraisers' interviews were based on the shipping campaign described in the U.S. Department of Energy's (USDOE) Draft Environmental Impact Statement (DEIS), and input from the State of Nevada's Agency for Nuclear Projects. Based on three transportation risk scenarios, and three types of properties – residential, commercial, and industrial – appraisers and lenders were asked for their perceptions of likely future impacts on property values in the shipment corridors. The survey was designed to measure the extent to which possible diminution effects may vary by distance from routes, type of property, and scenario. The survey results are then applied to the assessed valuation data for both routes and for each property type. This provides a first estimation of the magnitude of impacts that the experts believe may occur in Clark County.

Section 6.0 of this report applies the results of the lenders and appraisers survey to the following communities; Las Vegas, North Las Vegas, Mesquite, Henderson, and unincorporated Clark County. Specific issues related to the impacts within each of these communities are then briefly discussed. Appendix C provides details of the methodology used in the survey of Clark County bankers and lenders. Appendix D and Appendix E include the appraisers and lenders survey instruments. Appendix G includes tables supporting the results of the lenders and appraisers survey.

Section 7.0 compares the findings demonstrated in the literature with the results of the two surveys (the Clark County resident's survey and the lender's and appraiser's survey). While none of the methodologies used in this study can provide a precise estimate of the extent of property value diminution that may be experienced, the results from all three methodological approaches analyzed in this report suggest that Clark County's property values are likely to be adversely impacted as a result of the DOE's

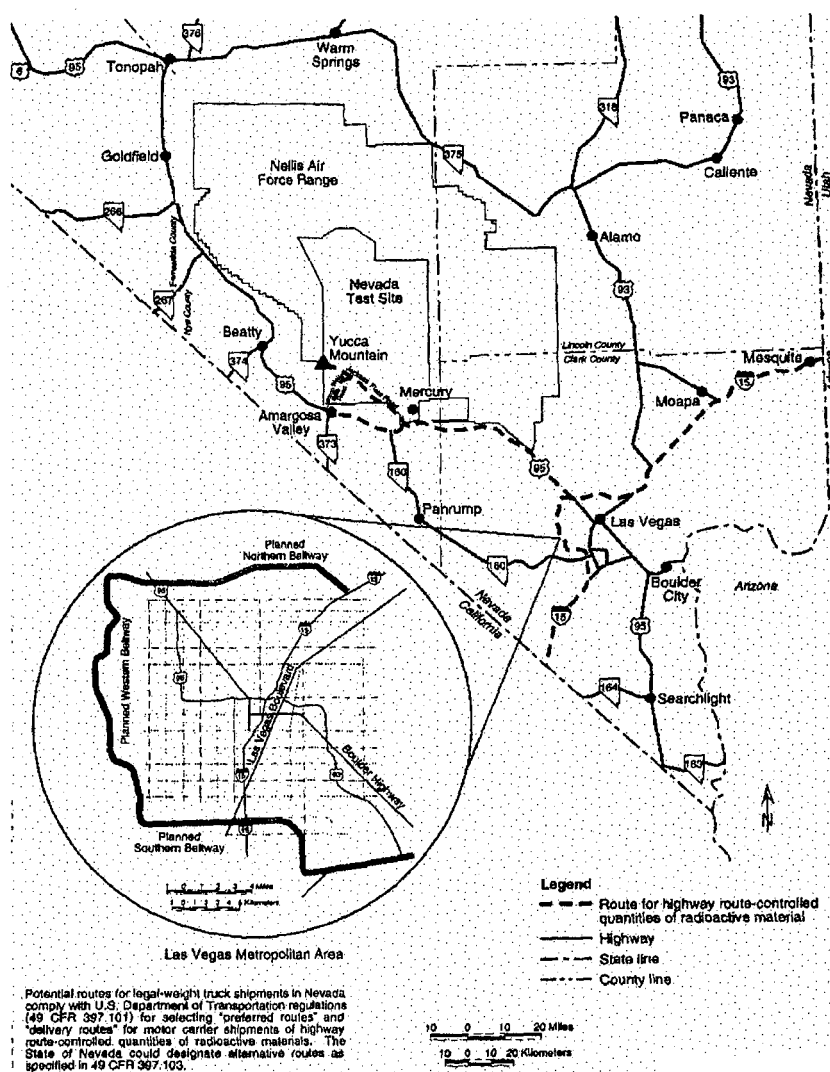
proposed actions. Further, a case is made that the estimates of impacts made by the lenders and appraisers under Scenario 2 provide the most reasonable proxy for the level of diminution that may be experienced in Clark County if the DOE proceeds with its plans to ship HLW through the County to the proposed Yucca Mountain Repository. Finally, Section 7.0 briefly discusses the implications of these findings for both residents and governmental entities within Clark County.

## **1.2 Background and Setting**

The area known as Clark County was annexed in 1867 from the Arizona Territory to the State of Nevada as part of Lincoln County. Clark County was formed in 1909 when Lincoln County was divided. From a population of 3,321, growth in Clark County remained slow until the Great Depression when government projects such as Hoover Dam drew laborers to Southern Nevada. After World War II, legalized gaming, and the warm climate continued to draw new residents to Southern Nevada. Clark County has witnessed one of the fastest growing populations in the United States. Today, this area is home to over 1.25 million residents and hosts another 30 million visitors annually.

If the Yucca Mountain repository is constructed and primarily truck transport is used to move the waste, the majority of all of the SNF and HLW waste will travel through Clark County (Figure 1). In this region of the country, no practical alternatives to I-15 and U.S. 93/95 are available for transit from Los Angeles, Salt Lake City, Phoenix, or Reno. Thus, while the USDOE has not selected the transportation routes it will use, the Draft EIS for Yucca Mountain does identify these routes among the options they are considering. If the USDOE's proposed mostly highway scenario is selected almost 93,000 shipments will traverse through Clark County over 24 years (Table 1).

**Figure 1 Clark County Transportation Corridors**



SOURCE: USDOE Yucca Mountain DEIS 1999

**Table 1 Number of HLW Truck Shipments**

Number of shipments per day	10.6
Number of shipments per week	74.4
Number of shipments per year	3,869
Total number of truck shipments over 24 years	92,851

Source: U.S. DOE's Yucca Mountain DEIS

### 1.3 Concepts and Definitions

Terms such as hazard, risk, risk perception, stigma, property value, and property value diminution, assessed valuation, and fair market value are not used consistently in the literature, especially across disciplines. For the purpose of this research, the following definitions are used. *Hazards* can be thought of as “threats to humans and what they value” (Hohenemser, Kates, and Slovic 1983). Hazards can be the result of a natural occurrence or they can originate from human activity (O’Riordan 1986). Nuclear power and its by-products are technological hazards that result from man converting a natural resource for man’s use.

*Risk* is the measure of both the likelihood of an event and the severity of harm. Thus, *hazards* are the source of *risk*. *Risk perception* is the “subjective value of the risk to which people react and respond” (Tobin and Montz 1997). *Stigma* is the additional risk perceived by the market associated with undesirable environmental features (Chalmers and Jackson 1996). Pijawka has noted that these features can result from an activity that the public finds repellent, upsetting, disruptive, or hazardous (Pijawka 1999).

*Property values* reflect the “anticipated stream of future benefits capitalized at a return necessary to attract capital to the opportunity” (Chalmers and Jackson 1996). When a property loses value because of an undesirable feature, the loss is measured by two components, the direct costs associated with eliminating or remediating the undesirable feature and stigma. This decrease in the value of the property is known as *property value diminution*. *Assessed valuation* is the value that a governmental agency places on land and buildings for purposes of computing property tax. Assessed value is usually computed as some percentage of fair market value. *Fair market value* represents “the most probable



price which a property should bring in a competitive and open market under all conditions requisite to a fair sale, the buyer and seller, each acting prudently and knowledgeably, and assuming the price is not affected by undue stimulus” (Appraisal Institute 1996). For example, in the State of Nevada property is assessed at 35% of its fair market value. This means that the property tax rate for a given jurisdiction is applied to an amount that County government, in this study Clark County, has determined represents 35% of the price that a property would likely be purchased for in an open and competitive market environment.

#### **1.4 Delimitations and Limitations of the Study**

The DOE proposal to build the Yucca Mountain repository and transport HLW from 79 sites across 43 states is of unprecedented magnitude in our nation’s history. Thus, while there is ample experience documenting the effects of negative environmental conditions on property values, there is no directly analogous case for what the DOE proposes to do in Clark County. Further, to-date, the DOE has yet to provide detailed information as to the exact nature of the shipment campaign. For example, although the existing transportation system provides a set of bounding parameters, the DOE has yet to detail the mode or routes for transporting the HLW to Yucca Mountain. Thus, much ambiguity and uncertainty is associated with making any forecast as to the potential impacts from these activities. Additionally, while the literature review in Chapter 3 provides a wide-ranging discussion of the factors that shape our behavioral responses that can result in stigma, we do not know what the long-term impacts on property values will be from the transportation of HLW. The literature review does provide a contextual

framework that allows us to understand the nature of stigma and the factors that influence its development.

Finally, the property value diminution reported on in this study are not based upon a formal appraisal of specific properties but is instead based on the opinions, perceptions, and beliefs of Clark County residents, lenders and appraisers as to the effects of the shipment campaign on property values along two routes under consideration. Because of the amplified perception of risk that is associated with nuclear related activities and because of the disproportionate share of the transportation program that will be felt by Clark County, Nevada, care should be given in any attempt to generalize the results from the study reported on here to other geographic locations. Chalmers and Jackson et al. have found that geographic location significantly effects lenders' perception of the additional risk (i.e., stigma) (Chalmers and Jackson 1996).

## **CHAPTER 2 METHODOLOGICAL APPROACH**

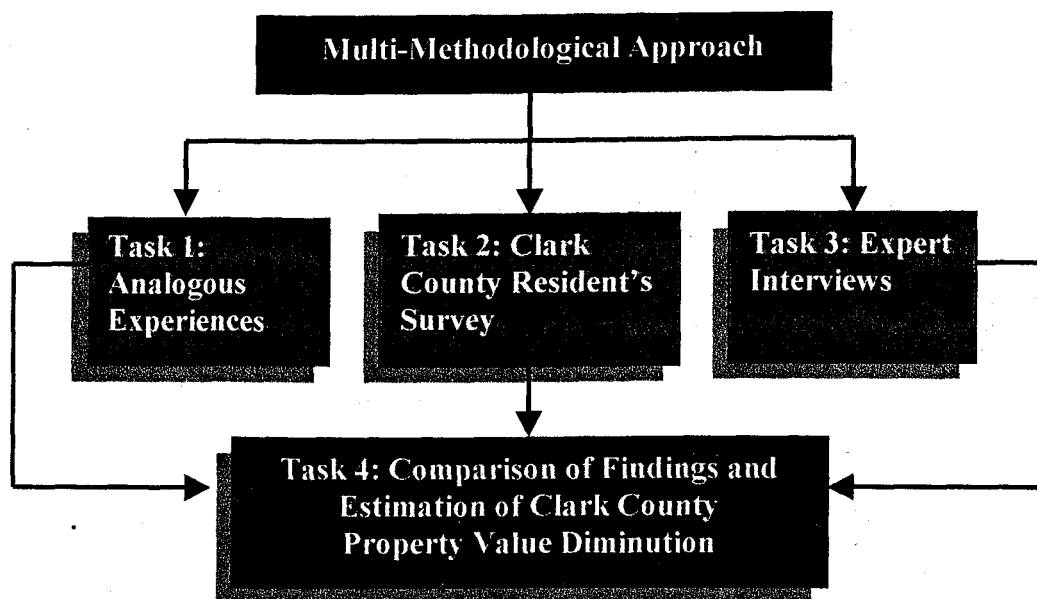
### **2.1 Forecasting with Uncertainty**

Mushkatel, Pijawka, and Nigg maintain that over one-half of the residents of Clark County consider the risk of an accident from the transportation of radioactive wastes to be serious or very serious (Mushkatel, Pijawka, and Nigg 1993). Despite this finding, there has been limited research into how stigma influences property values during the transport of radioactive waste. The most substantial study of these effects has been the investigation of property value impacts from the transport of radioactive waste materials from foreign reactors shipped to the Savannah River Site for storage during the mid 1990s (Gawande and Smith 1999). Gawande and Smith found that property values declined significantly along the transportation corridor for radioactive wastes in an urban county but not in two rural counties. Most other studies have probed how the perception of risk has influenced the attitudes of businesses or community residents toward nuclear facilities

### **2.2 Research Design**

This research utilizes a multi-method approach to investigate the extent of potential stigma-induced property value diminution that may result from the transport of HLW through Clark County, Nevada along the routes under consideration by the DOE for shipping HLW to the proposed repository at Yucca Mountain, Nevada (Figure 2 and Table 2).

**Figure 2 Multi-Method Research Design**



**Table 2 Valuation Methods**

Component	Definition of Purpose	Stakeholder		
		Lenders	Appraisers	Public
Analogous Case Experience	Document the literature to determine whether the range and magnitude of impacts that have been associated with other adverse environmental conditions are analogous to and can inform our understanding of the potential property value impacts within Clark County resulting from the DOE's proposed actions.	✓	✓	✓
Real Estate Market Survey	Focused interviews of current and potential homeowners in Clark County to identify perceptions and attitudes about the affects on property values resulting from the transport of HLW.			✓
Expert Interviews	Scientifically survey real estate appraisers and lenders in order to measure the affects of stigma on property values in Clark County under various transportation scenarios for SNF and HLNW.	✓	✓	

Source: Conway 2001

The research design combines an analysis of analogous cases from the literature, a survey of Clark County residents, and scenario-based expert interviews (Figure 2 and Table 2). The rationale for using these techniques is discussed below. The details of the methodologies employed in the Clark County survey of residents are included in Appendix A. The survey instrument is attached as Appendix B. The details of the survey methodology for the appraisers and lenders are included in Appendix C. The survey instruments are attached as Appendix D and E. Appendix F and H contain tabular results from the residents' and experts' survey, respectively.

#### **2.2.1 Analogous Case Experience**

*Analogous Case Experience* was gathered from a variety of secondary sources including the risk perception and property value literature, Appraisal Institute text materials, expert reports, and court documents. The literature describes other more limited campaigns to transport radioactive wastes. The literature review includes some simple descriptive statistics that demonstrate the range of variances, based on research studies, that have been shown for certain types of environmentally induced property value diminution. Given the lack of direct analogous experience with a campaign to transport nuclear waste of the scope proposed by DOE, the emphasis is on providing a qualitative, contextual framework for understanding the factors that are likely to influence property values in Clark County because of the transport of HLW to Yucca Mountain.

### **2.2.2 Clark County Residents' Survey**

Over the last 15 years, there have been a growing number of public opinion surveys addressing the intensity of concerns and public perceptions of the risks of transporting nuclear wastes on nearby routes. These surveys have typically targeted areas or regions containing proposed nuclear waste transportation routes, and the objectives of the surveys were to discern residents' concerns and, in some cases, what their likely behavior might be if these routes were selected. The DOE through the State of Nevada's, Nuclear Waste Project Office, funded a number of studies to assess how residents of the State, Clark County, and the Nation perceive the risks of transporting nuclear waste and what, if any, concerns arise as a result of the shipments.

In addition to these surveys, the opening of the WIPP near Carlsbad, New Mexico, resulted in another survey of not only the public's risk perceptions, but also the public's beliefs about the possible impacts on property values of homes and businesses near proposed routes. Concerns over property value losses by developers and residential homeowners regarding a bypass route in Santa Fe, New Mexico, to transport nuclear waste materials for disposal in the WIPP resulted in a systematic survey of people's perceptions of property value impacts from radioactive waste transportation (ZIA Research Associates 1990).

The "Santa Fe" survey is important in three distinct ways. First, it demonstrated that residents believe that the transportation of radioactive waste would adversely impact property values. Second, the survey results were important in a judicial decision demonstrating that damages in terms of devaluation of property values can be compensated because of stigma perceptions (Komis vs. Santa Fe). Third, the survey's

design allows crosswalks to the survey of Clark County residents. The Komis case in New Mexico is relevant to Clark County, Nevada, because it illustrates that residents' perceptions of property values *do matter* to the courts and that these perceptions may influence market behavior.

The survey of Clark County residents' summarized in section 4.0 and detailed in the report, *Clark County Residents and Key Informant Surveys: Beliefs, Opinions, and Perceptions about Property Value Impacts from the Shipment of High-Level Nuclear Waste through Clark County, Nevada*, is the first systematic survey of perceptions undertaken to measure potential property value impacts resulting from the proposed shipments of HLW. The Clark County residents' survey employed many of the questions found in the ZIA Research Associates survey, and the results of the two surveys were compared. Although the two studies were conducted in two different geographic locales and over a decade apart, the results indicate a strong relationship among the public's perception of impacts. The similarities in these findings support the conclusion that residents believe that property values will be diminished from radioactive waste transport.

### **2.2.3 Real Estate Market Survey**

Property value is directly influenced by the attitudes and behaviors of market participants including real estate appraisers, lenders, and owners. The first component of the research discusses actual levels of property value diminution resulting from adverse environmental conditions. The second component reports on the perceived level of property value diminution by Clark County residents. The third component draws on the experience of appraisers and lenders within Clark County. Clark County appraisers and lenders were interviewed to assess their beliefs and perceptions about the extent of

property value diminution that could occur under three different transportation scenarios for three different property types, and at distances varying from one mile to three miles along the proposed transportation routes.



## **CHAPTER 3 EXPERIENCE WITH PROPERTY VALUE DIMINUTION RESULTING FROM ADVERSE ENVIRONMENTAL CONDITIONS**

### **3.1 Nature of the Literature**

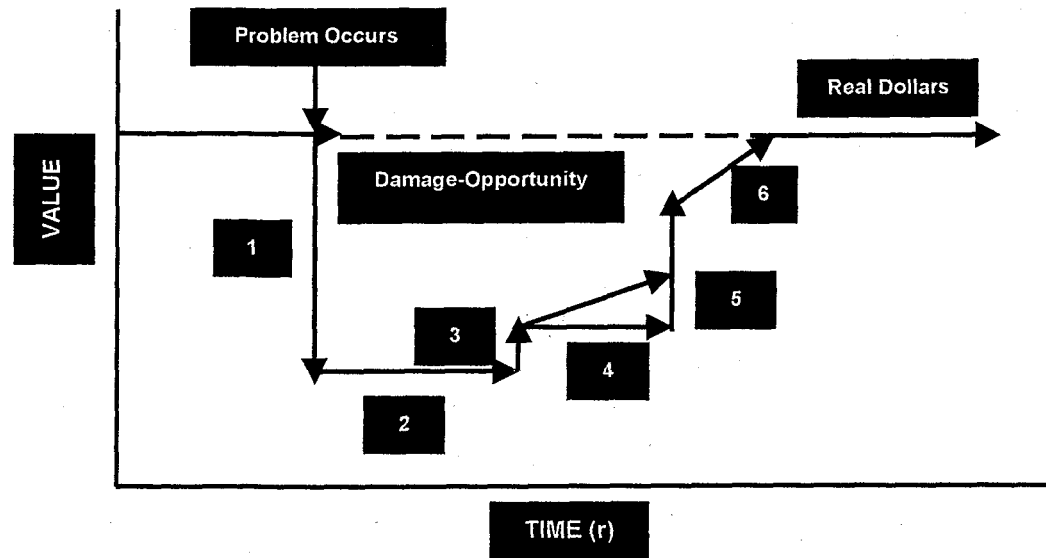
Adverse effects on property values, from a variety of environmental conditions, have been demonstrated since as early as the beginning of the last century. It is only within the last two decades, however, that social scientists, environmental planners, economists, real estate appraisers, and lawyers have begun to actively integrate how human behavior interacts with other market factors. These efforts have spawned an extensive literature that seeks to explain the factors that influence stigma-induced property value diminution.

This literature falls broadly into two categories. The first category includes the many studies that have been done linking stigma to property value diminution, while the second category focuses on developing theoretical models that describe the interactions that result in stigma-induced property value diminution (Patchin 1988; Mundy 1992; Nuestein 1992; Chalmers 1993; Chalmers and Jackson 1996; Reichert 1997).

The theoretical models developed have focused primarily on a description of the effects of stigma on marketability (Figure 3) and income (Figure 4) (Mundy 1992). Mundy argues that when an adverse environmental event occurs, the marketplace acknowledges the event by dramatically reducing the marketability of the property until the extent of damage can be quantified, and remediation undertaken. When the marketplace recognizes that the remediation is complete, the marketability of the property returns. The period between the recognition by the marketplace that an adverse environmental event has occurred and the marketplace's acknowledgement that a

successful remediation has occurred results in “damages” associated with lost opportunity costs (Figure 3).

**Figure 3 Marketability Effects**

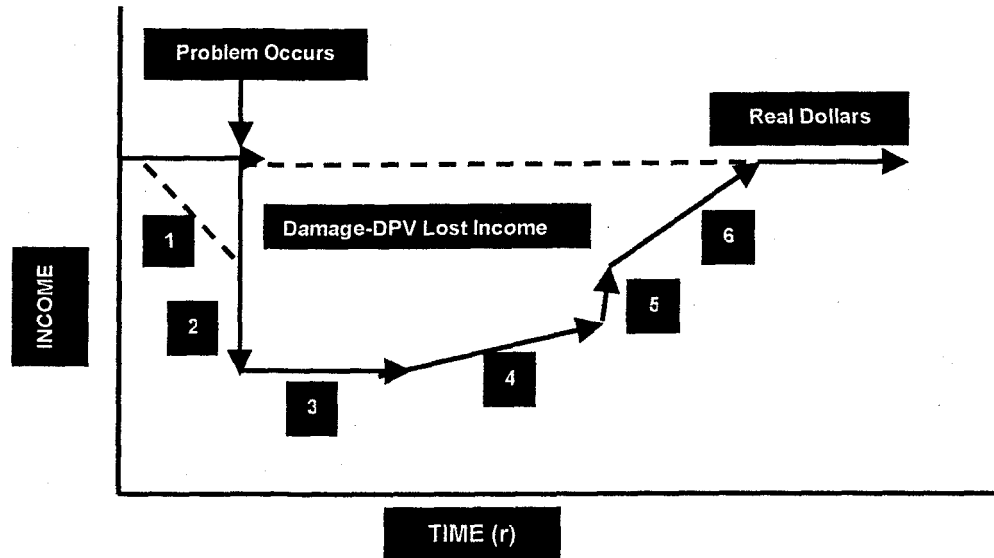


Source: Mundy 1992

Similarly, an adverse environmental event also can affect a property’s ability to generate income (Figure 4). This effect may result in a sudden downturn, for example, if a property is immediately destroyed or the effect can be gradual. Gradual income loss can occur when tenants refuse to renew their lease because of an adverse environmental event. In either case, the property’s ability to generate income will remain depressed until the market recognizes that the property has been fully remediated. The period of reduced income results in property value diminution resulting from lost income.

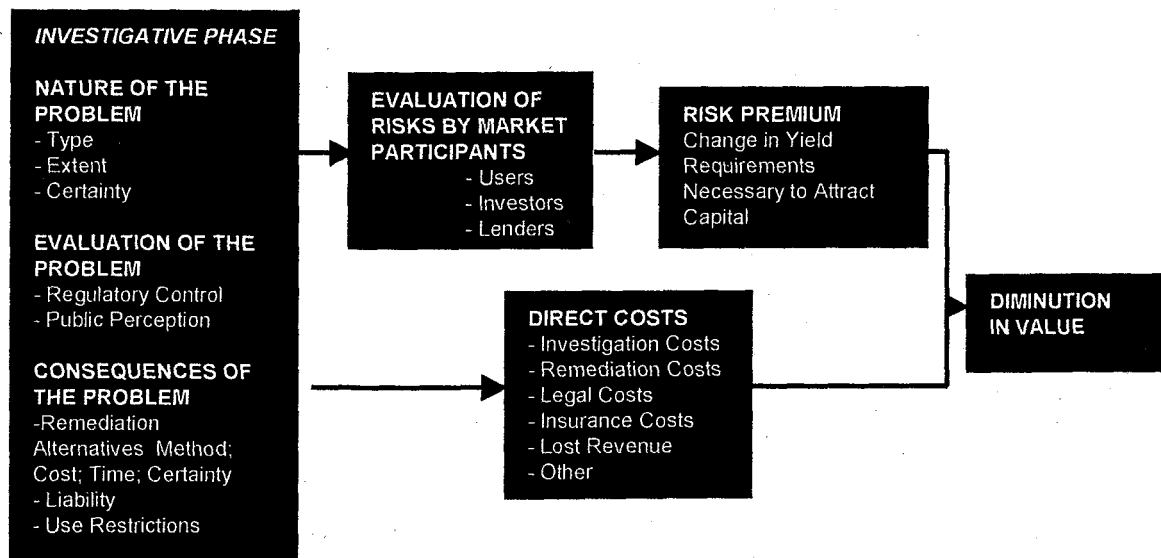
Chalmers has taken these concepts even further by establishing a conceptual framework for quantifying stigma-induced property value diminution (Figure 5). Others have focused on explaining how situational factors, such as the physical and socio-economic environment, interact with cognitive factors such as psychological variables to influence our perceptions (Tobin and Montz 1997).

**Figure 4 Income Effects**



Source: Mundy 1992

**Figure 5 Property Value Diminution Conceptual Framework**



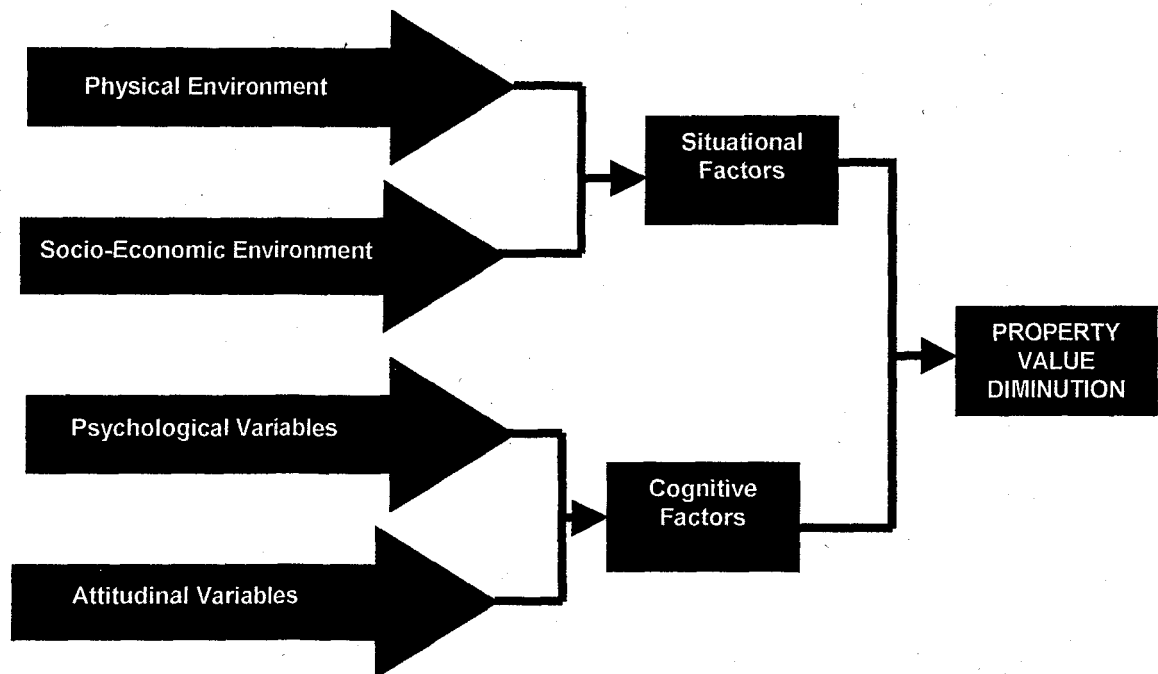
Chalmers 1996

### 3.2 Factors Influencing Property Valuation Diminution

#### 3.2.1 Situational Factors Influencing Property Value Diminution

As noted above, several models have been developed to describe the factors that influence how property values vary as a function of perceived risk-induced stigma (Mundy 1992; Chalmers 1996). This investigation utilizes a modification of the model developed by Tobin and Montz to explain our current understanding of the nature of the perception of risk and formation of stigma. The model also provides a framework for synthesizing the literature on property value diminution (Tobin and Montz 1997) (Figure 6).

**Figure 6 Influences on Property Value Diminution**



Source: Modification of Tobin and Montz Risk Perception Model 1997

In section 3.2.1.1.1 and 3.2.1.1.2, the situational and cognitive factors that influence property value diminution are discussed. When the literature about property value diminution is viewed in this framework, it becomes evident that the value of property, like the perception of risk, is dynamic and complex involving the interaction of multiple factors.

### **3.2.1.1 Physical Factors**

Informally, humankind has been assessing the value of land for centuries. Formal economic price theory dates back to the early 1800s when Heinrich von Thunen developed his agricultural location model. According to von Thunen's model, the value of property (bid rent) was a function of distance to marketplace in relationship to the land's utility. By the early 1930s, Walter Christaller had developed Central Place Theory, although it was not widely accepted until the mid-1950s. By then, the real estate appraisers were already tackling the methodological challenge of determining how to account for the effect of negative externalities (i.e., unintentional effects on a third party, who as a result may suffer uncompensated losses) from the siting of transmission lines across a property (Crawford 1955).

The growing environmental movement in the 1970s sparked research into the effect of pollution on property values. Initially, this work did not directly incorporate cognitive factors, but instead attempted to measure direct cost of contamination on a property. For example, Harrison and Rubinfeld investigated the relationship between the marginal value of clean air and property values (Harrison and Rubinfeld 1978). By the 1980s, a plethora of literature began to deal with the effects of risk perception on property values (Patchin 1988; 1991; McClelland et al. 1990; Smolen et al. 1992; Mundy 1992;

Elliott-Jones 1992; Carroll et al. 1996; Pijawka 1998; Gawande and Jenkins-Smith 1999). Property valuation studies have focused on the risk perceptions of the public, and experts that include real estate appraisers and lenders.

#### **3.2.1.1.1 Type of Hazard**

The literature indicates that a wide variety of environmental disamenities from high-voltage transmission lines to Superfund sites and hazardous waste landfills and incinerators can result in stigma-induced property value diminution (Colewell 1990; McClelland et al. 1990; Greenberg and Hughes 1991; Kiel and McClain 1995; Smolen et al 1992). In a 1978 study, Lindell et al. found that only twenty-nine percent of the public would be willing to live within 10 miles of a nuclear waste facility and thirty-two percent stated that they were unwilling to live within 100 miles of a nuclear waste facility. Further, this study found that a nuclear waste repository was the least tolerable of eight industrial facility types including a nuclear power plant (Lindell et al. 1978). A 1997 national survey by Flynn et al indicated that 63.6 percent of the sample agreed or strongly agreed that property values along the transportation corridor for HLW would decline. Similarly, seventy percent of the respondents to a survey in Santa Fe, New Mexico indicated that property values would fall along a proposed bypass that was proposed for the transportation of radioactive waste to the Waste Isolation Pilot Project (WIPP) near Carlsbad, New Mexico (ZIA Research 1991). Sixty percent of those respondents also indicated that under *no conditions* would they purchase homes in proximity to the proposed bypass (discussed in detail in Section 4.0).

In 1999, Gawande and Jenkins-Smith demonstrated property value diminution from the transport of HLW in South Carolina (Gawande and Jenkins-Smith 1999). Using a hedonic modeling approach, Gawande and Jenkins-Smith analyzed 9,533 real estate

transactions within three counties in South Carolina where HLW was transported over a two-year period between 1994-1996. They found that although property value diminution could not be discerned in the two rural counties, property values in the urban county were substantially lowered during the period that HLW was being transported.

#### **3.2.1.1.2 Factors of Magnitude and Scale**

Even small amounts of contamination have been shown to negatively affect property values (Egar 1973; Patchin 1988). In a 1991 survey of lenders, the Hanford/Healy Companies found that less than 40 percent of the banks would consider lending on a property that was contiguous to a contaminated site (Healy and Healy 1992). Bankers also indicated that they would require additional indemnification (66%), adjust the loan-to-value-ratio (46%), or require some type of other personal guarantee (60%).

Chalmers has identified that the extent of contamination as one of the four key factors effecting property value diminution (Chalmers 1993). He reasons that if the extent of the contamination is small, and is subsequently completely remediated, there may be no impact on housing prices. However, if the extent of contamination is large, or there is distrust in the degree of remediation or the entity responsible for the remediation, then housing values may be lowered significantly (Chalmers and Jackson 1996).

Research to determine whether the level of toxicity influences changes in property value diminution is ambiguous. Kohlhasse examined housing sales in Houston's Harris County between 1976 and 1985. He found that while sale prices were significantly lower in areas near Superfund sites, no discernable differences could be found in the sale process related to the extent of contamination (Kohlhasse 1991). Greenberg had similar findings in his investigation of 77 Superfund sites in New Jersey (Greenberg 1992). These studies assume factors that may not be fully indicative of whether differentials can and do

exist based on the extent of contamination. Both Kohlhasse and Greenberg utilized the National Priorities List (NPL) ranking of Superfund sites as a proxy for extent of contamination (the NPL ranks sites according to their seriousness using a health risk index) to measure differences in the public's perception of risk. During the time period NPL sites were being studied by Kohlhasse, there was limited knowledge and understanding of the nature of the NPL among the public (Conway 1990).

#### **3.2.1.1.3 Temporal Patterns**

The influence of temporal patterns on variations in property values has been widely documented (Patchin 1988; Stock 1989; Colwell 1990; MacGregor and Slovic 1993; Kohlhasse 1991; Patchin 1991; Ketkar 1992; Chalmers 1993; Chalmers and Jackson 1996; Kiel et al. 1995; Carrol 1996). Most of this research indicates that reductions in property value will rebound over time after remediation has been completed. Chalmers notes that if the remediation is perceived to be inadequate, or if there is a breakdown in trust of those responsible for remediating a site, then stigma is likely to remain (Chalmers 1993; Chalmers and Jackson 1996). Further, when Kiel and McClain used a hedonic regression model to measure how housing prices varied over time and distance during the construction and operations of a hazardous waste incinerator, they found that both time and distance were significant and dynamic factors influencing changes in property values. Even after the incinerator had been operating for 4 years, a significant diminution of property values remained (Kiel and McClain 1995).

Patchin also has found that from the time of discovery of contamination on a property to full remediation, the property may not be marketable (Patchin 1991). Further losses in property values can occur if cleanup is delayed and this loss can be substantial. In fact, Kiel and McClain argue that an economic efficiency model does not adequately



capture the equity effects that result from the distributional imbalances that occur from the time the public becomes aware that a property is contaminated and the point when the public accepts the remediation as complete (Kiel and McClain 1995).

#### **3.2.1.1.4 Distance**

The predominance of findings from the literature indicate that distance can significantly influence property value variances (Havlicek et al. 1972; Blomquist 1974; Webb 1980; Nelson 1982; Colwell 1990; McClelland et al. 1990; Kohlhasse 1991; Ketkar 1992; Mendelsohn et al. 1992; Smolen et al. 1992 and 1997; Kiel 1995; Kiel and McClain 1995). In a survey of resident perceptions of the impact of a nuclear power plant on property values, Webb found that there is a significant “distance decay” factor, whereby those living closest to the reactor indicated the greatest property values diminution (Webb 1980). Other researchers have also found that the rate of property value diminution decreases over distance, forming a distance gradient (Colwell 1990; Nelson 1982; Smolen et al. 1992).

Mendelsohn et al. analyzed panel data on repeated sales in New Bedford, Massachusetts and found that proximity to polluted waters resulted in property value reductions of \$7,000 to \$10,000 per individual property (in 1989 prices), with an aggregate loss of \$36 million (Mendelsohn et al. 1992). Using a sample of Boston area housing prices from 1975 – 1992, Kiel found that there was a premium of \$3,000 to \$6,000 for each mile of distance away from a Superfund site (Kiel 1995).

Similarly, Reichert measured the stigma-induced property value diminution resulting from a landfill designated as a Superfund site in Uniontown, Ohio. Reichert found diminution in property values of just under \$11 million for 1,600 residential properties. The rate of property value diminution found varies from 5 percent at 6,750 feet

to 15 percent for properties nearer the landfill (Reichert 1997). Reichert points out that the average property value diminution from his research at Uniontown is consistent with earlier research by Kohlhasse, Smolen, and Miller that found the rate of property value diminution varied with distance (Kohlhasse 1991; Smolen 1992; and Miller 1992). Further, the average rate and average dollar amount of diminution at one mile was relatively consistent among these researchers (Table 3).

**Table 3 Impacts in Average Dollars and Percentages for Properties One-Mile Away from a Landfill**

Kohlhasse (Houston, Texas)	\$12,728	16.2%
Smolen (Toledo, Ohio)	8,141	14.2%
Reichert	7,880	7.6%
Miller	7,188	12.0%
<b>Overall Average Impact</b>	<b>\$8,984</b>	<b>12.5%</b>
<b>Standard Deviation</b>	<b>\$492</b>	<b>3.4%</b>

Source: Reichert 1997

Gamble and Downing maintain in their studies of the impact of nuclear power plants on property values, that proximity is not a factor (Gamble and Downing 1982). Gamble investigated residential property values near four nuclear power plants in the Northeast prior to the TMI accident, and residential property values in proximity to TMI after the accident. Gamble used a hedonic model to analyze the sale of 540 single family homes in proximity to the four nuclear power plants in the Northeast and to analyze the sale of 695 single family homes in the TMI area. Gamble and Downing found that nuclear power plants had no discernable effect on the value of properties studied in the Northeast. For the properties in proximity to TMI, Gamble, and Downing found a “sharp decline in

property values” in the immediate period after the accident. However, property values quickly rebounded (Gamble and Downing 1982). Gamble notes that the influx of cleanup contractors after the accident at TMI may be partially responsible for this finding.

McCluskey and Rausser measured the complex and dynamic interaction between distance and temporal patterns on property value diminution (McCluskey and Rausser 1999). Using a hedonic price model, they examined how property values varied overtime and distance before the announcement of contamination at a smelter in Dallas, Texas and during two phases of environmental remediation. This research indicates that properties closest to the smelter experienced property value diminution even before contamination was discovered at the smelter. Upon discovery, amplified perception of risk was found to lead to further diminution that declined over distances out to four miles.

Change in property values was assessed from 1979 – 1995, a period that included two separate clean up campaigns. The research indicates that property values recover over time at locations greater than one mile but that a permanent stigma remains within the one-mile area. This finding has important implications for estimating the extent of property value diminution for ongoing facilities, and for long-term projects such as the transportation of HLW over three decades. If the rate of property value diminution changes over distance and time, it is critical that monitoring systems measuring impacts be calibrated to measure changes in property values at various scales and across an extended period in order to capture the dynamic affects of time and distance.

### **3.2.2 Cognitive Factors Influence on Property Value Diminution**

By the 1990s, there was a plethora of literature linking the perception of risk from contaminated sites, hazardous waste facilities and the transportation of hazardous

materials to property value diminution (Patchin 1988; 1991; McClelland et al. 1990; Smolen et al. 1992; Mundy 1992; Elliott-Jones 1992; Carroll et al. 1996; Pijawka 1998; Gawande and Jenkins-Smith 1999). During this period, social scientists clearly established the links between environmental risk-induced stigma and property value diminution. Economists and real estate appraisers focused their attention on identifying methodologies for quantifying property value diminution resulting from environmental risk-induced stigma. Most of the property value literature during this period is quantitative, depending on surveys and statistical modeling. Like the risk perception literature, the literature on property value diminution, also begins to reflect more multi-disciplinary and multi-methodological approaches during this period.

#### **3.2.2.1 Knowledge**

In Harris County, Texas, a hedonic model was used to measure how knowledge of a hazardous waste site affects property values (Kohlhase 1991). The research found that prior to the United States Environmental Protection Agency publicly announcing that a site had been added to the National Priority List (the list that ranks Superfund sites) that there was no property value loss related to the contamination at the site. After EPA's announcement however, there was a sharp decline in property values.

Mendelsohn in his investigation of the effects of PCB contamination in New Bedford harbor on residential property values also found that before broad public awareness of the contamination, the effects on property values were limited. As public knowledge of the contamination increased, property value diminution grew to \$7,000 - \$10,000 per home (in 1989 dollars) (Mendelsohn et al. 1992).

Furthermore, Payne et al. found that just the knowledge of a Low-Level Radioactive Waste site is sufficient to have adverse effects on property values (Payne et al. 1987).

### **3.2.2.2 Perception**

The link between the perception of risk and property value diminution is illustrated in a 1997 national survey, where respondents indicated that they expected nuclear waste shipments to have a deleterious effect on property values (Flynn et al. 1997). McClelland et al.'s research also illustrates the link between risk perception and property value diminution (McClelland et al. 1990). McClelland et al. used a hedonic price regression model to measure changes in property values resulting from changes in the collective risk judgment of neighborhoods. After controlling for a variety of housing characteristics including property size, age, amenities, and disamenities, they found that for each 10 percent increase in the share of respondents who perceived the highest levels of risk, average housing prices decreased by \$2,084.

When real estate lenders were surveyed to determine how their perception of risk influenced their underwriting policy, Hanford and Healy found that less than 40 percent of bankers would even consider lending on a parcel of land contiguous to a contaminated site. Further, 66 percent of these lenders indicated that they would require additional indemnification and 46 percent indicated that they would adjust the loan-to-value ratio (Healy and Healy 1992).

In contrast, Metz and Clark argue that preference surveys that link the perception of risk to property value diminution are not indicative of actual behavioral outcomes (Metz and Clark 1997). To make their case, Metz and Clark used four different hedonic

models to investigate the sale of 765 homes near the Rancho Seco nuclear power plant and 400 homes near the Diablo Canyon nuclear power plant. Their research found that the operational status of the nuclear power plant and the activities related to the transfer of spent fuel into dry cask storage had no deleterious affect on housing prices in California.

### **3.2.2.3 Values**

Chalmers has argued that one of the most complex challenges in assessing property value diminution is the “development of a clear definition of the value concept” (Chalmers, 1993). Since there is a significant disparity between the value of property in use and the value of property for exchange, different definitions and methodologies have been used to define “value.”

Case law and legislative statutes have largely relied on “market value” as the appropriate measure of “value.” Market value is “the price at which a willing seller would sell and a willing buyer would buy, neither being under abnormal pressure” (American Institute of Real Estate Appraisers 1978). Often market valuation is assessed by comparing the value of a property to similar properties in the geographic area. The application of “market valuation” for contaminated properties can be problematic. For example, if a government entity chose to condemn a piece of land that has become contaminated by the actions of another party from a property owner, the “market value” proposed for payment by the government entity to the property owner could be zero. When valuation of contaminated properties is considered for ad valorem taxation, the tax courts have broadened their determination of value to emphasize “liability or fault” (Gladstone 1991; Dunmire 1992; and McMurray and Pierce 1992).

### **3.3 Implications of the Literature Review on Clark County Property Values**

A preponderance of the research indicates that stigma-induced property value diminution can and does occur. The literature also indicates that there are multiple factors both real and perceived that influence stigma. These factors are dynamic and to date have not been fully quantified.

The literature also demonstrates that stigma-induced property value diminution has been recognized by the courts. This court recognition is discussed in detail in Section 4.0. Formal protocols to measure stigma effects in property values have been developed by experts, such as appraisers. Lenders have developed formal policies for dealing with stigma. The acknowledgement of the effects of stigma on property values by the courts and other experts suggest that it is both reasonable and prudent to consider the potential effects of the Yucca Mountain Project on Clark County's property values.

## 4.0 RESIDENTIAL SURVEY RESULTS

This section of the report summarizes the results of a survey that is described in detail in the report, *Clark County Residents and Key Informant Surveys: Beliefs, Opinions, and Perceptions about Property Value Impacts from the Shipment of High-level Nuclear Waste through Clark County, Nevada*. The results are applied to the assessed valuation data for three groups of land uses within Clark County. The survey of 512 Clark County residents was conducted by the Canon Center at University of Nevada at Las Vegas (UNLV) in August of 2000.

“The purpose of the survey was to identify the attitudes, opinions, and perceptions of residents of Clark County, Nevada regarding property values in Clark County, and to characterize their beliefs about the potential impacts of the proposed shipments on property values along the transportation corridor” (UER February 2000). The results of the survey are summarized below in sections 4.1 – 4.4 and then applied to residential, commercial, and industrial assessed valuation data for Clark County along two potential routes in section 4.4. The methodology is discussed in Appendix A, and the survey protocols are attached as Appendix B.

### 4.1. Interest in Residential Property Ownership

Respondents were asked if they presently owned any residential property in Clark County and whether they had plans to buy residential property in Clark County (Appendix A). Greater than 60% of those surveyed stated that they currently own residential property in Clark County and more than 30% stated that they planned a future purchase of residential property within the County. These responses indicate that there is a strong



preference toward home ownership among Clark County residents (Appendix F - Table 2).

## **4.2. Opinions Regarding Residential Property Values in Clark County**

### **4.2.1 Changes in Residential Property Values**

In response to questions about the direction of residential property values in Clark County, almost three-fourths of Clark County residents said that they believe residential property values in Las Vegas Valley and throughout Clark County are increasing. Another 15.8% indicated that property values are remaining about the same, while only 2.1% believe property values are decreasing. These results are similar to an earlier survey of Santa Fe, New Mexico residents that found 87% indicating property values were increasing before the DOE implemented a shipment campaign of radioactive transuranic waste to the WIPP facility at Carlsbad, New Mexico.

### **4.2.2 Impact of Various Facilities or Environmental Conditions on Residential Property Values**

Respondents were asked whether twelve different types of facilities or “environmental conditions” would *increase, decrease, or have no effect* on nearby residential property values. These facilities or “environmental conditions” included:

- Casino or gaming property
- Amusement park
- Day care center
- Landfill and waste dumping site
- Nonpolluting manufacturing facility
- Public school
- Limited access highway
- Horse racing track
- Polluting manufacturing plant
- Shelter for the homeless

- Shopping center
- Limited access highway or freeway used to transport nuclear waste

Clark County residents indicated that having a public school and a shopping center nearby has a positive impact on property values, by 61%, and 52.2%, respectively.

Respondents stated that a polluting manufacturing plant, a landfill, and a highway or freeway used to ship nuclear waste would have the most negative affect on property values. The findings correlate with the Santa Fe, New Mexico study.

The survey results were analyzed to determine if the responses to each of these environmental conditions varied by any of the demographic variables measured. These demographic variables included the respondent's length of residency in Clark County, age, education, ethnicity, income, gender, property ownership, and the respondent's residential community. No statistically significant differences were identified for the three facilities receiving the highest negative ratings (freeways used to ship nuclear waste, a polluting manufacturing facility, or a landfill) in Clark County. In the earlier survey of Santa Fe County, New Mexico residents, significant differences in perceptions of property value impacts were shown for several demographic variables including age, gender, and household income (Table 4). In the Santa Fe study, respondents between 30-44 years of age, females, and those with incomes between \$15,001-\$40,000, were more likely than others to believe that residential property values would decrease with a nearby freeway transporting nuclear waste. Males and higher income Santa Fe residents (incomes greater than \$40,000 at the time of the survey) were *more likely* to believe that a freeway with nuclear waste shipments would have no effect on residential property.

**Table 4 Freeway Used to Ship HLW Waste by Demographics**

Freeway Used to Ship Nuclear Waste by Demographic	Significant Difference	
	Nevada	New Mexico
- Length of Residency	No Significant Difference	No Significant Difference
- Age	No Significant Difference	Significant Difference
- Education	No Significant Difference	No Significant Difference
- Ethnicity	No Significant Difference	No Significant Difference
- Income	No Significant Difference	Significant Difference
- Gender	No Significant Difference	Significant Difference

#### **4.3 Familiarity with USDOE's Repository and Transportation Program**

Clark County residents were asked if they were familiar with the Yucca Mountain repository project and the DOE's plans for HLW waste shipments through Clark County. Approximately 80% of the respondents indicated that they were familiar with the Yucca Mountain project, while 75% said that they knew about the DOE's plans to ship HLW through Clark County (Appendix F -Table 32).

#### **4.4. Perceptions of the Impacts of Nuclear Waste Shipments on Property Values**

##### **4.4.1 Likelihood of Purchasing Residential Property**

Respondents were also asked whether a property's location near a HLW transportation route would – increase a lot, increase somewhat, neither increase nor decrease, decrease somewhat, or decrease a lot – the likelihood of purchasing property (Table 5). Altogether almost 82% of the respondents stated that a nearby HLW route would either “decrease a lot” or “decrease somewhat” their likelihood of purchasing a residential property.

**Table 5 Likelihood of Purchasing Residential Property near a HLW Transportation Route in Clark County, Nevada**

Chances of Buying Property Would...	Percent (N)
Increase a lot	2.7% (14)
Increase somewhat	2.3% (12)
Neither increase nor decrease	10.2% (52)
Decrease somewhat	11.1% (57)
Decrease a lot	70.7% (362)
Do not know/no answer	2.9% (15)
<b>TOTAL</b>	<b>100.0% (512)</b>

#### 4.4.2 Effects on Property Values: Open-ended Responses

In addition to the closed-ended questions in the survey, the following three open-ended questions were asked to uncover residents' perceptions of the effect shipments of high-level nuclear waste would have, if any, on property values.

- (1) "The U.S. Department of Energy has indicated that Interstate 15, U.S. 95, State Route 160, and the northern and southern beltways could all be used for high-level nuclear waste shipments to Yucca Mountain. What effect, if any, do you believe shipments of high-level nuclear waste will have on property values located near these highways?
- (2) How do you think commercial property, or business property values near routes used for the shipment of high-level nuclear waste in Clark County will be affected, if at all?
- (3) Under what conditions would you consider purchasing residential property near a highway that is to be used for the shipment of high-level nuclear waste in Clark County?" (UER August 2000)

The responses to these open-ended questions were categorized and coded. Among the initial responses as shown in Table 6, almost two-thirds of those surveyed indicated that properties near possible shipment routes would *decrease* in value.

**Table 6 Perception of Residential Property Value Impacts Located near Specific Routes in Clark County, Nevada (NV) versus Santa Fe, New Mexico (NM)**

Response Category	Nevada Percent (N)	New Mexico*
Danger**	2.4% (12)	NA
Decrease in value	66.1% (327)	71.0%
No effect	12.7% (63)	16.0%
Do not know	3.4% (17)	5.0%
Pretty bad**	2.4% (12)	NA
Negative effect**	5.3% (26)	NA
Upset people**	1.8% (7)	NA
People move**	1.7% (8)	NA
Increase in value	0.6% (3)	5.0%
No one will buy houses**	0.6% (3)	NA
Other	3.0% (15)	3.0%
TOTAL	100% (495)	100% (489)

\* All percents are rounded to the nearest whole number and only the total N was available for comparison.

\*\* NA - Categories not used in the Santa Fe, New Mexico survey

Altogether, 78% of the respondents utilized negative terms to describe the effects of the proposed HLW shipment campaign through Clark County. Among the other terms used to describe the effects of the shipment campaign on property values were a “negative effect,” “pretty bad,” “upset people,” “people would move far away,” and “no one will buy houses.” In response to a similar closed-ended question, 71% of the Santa Fe, New Mexico residents surveyed indicated that property values would decline from the shipment of radioactive wastes.

Both surveys also questioned respondents about their views concerning potential nuclear waste transportation impacts on nearby commercial or business property (Table 7). In this case, 40.7% of the Clark County respondents indicated that commercial property would decrease with another 5.8% indicating generally “negative effects” on properties. Interestingly, 6.2% responding to this open-ended question suggested adverse effects on business operations located near these routes. In contrast to the general

question on property values, 33.9% of responses to the question on commercial properties indicated that there would be “no effect” on these values. The respondents to a similar closed-ended question in the Santa Fe, New Mexico survey indicated that 37% of the respondents believed that commercial or business property values would decline along the shipment corridor to WIPP, while 38% stated that the shipment campaign would have “no effect.”

**Table 7 Perceptions of Property Value Impacts on Commercial or Business Properties**

Response Category	Nevada Percent (N)	New Mexico Percent *
Decrease in value	40.7% (231)	37.0%
No effect	33.9% (192)	38.0%
Do not know	7.2% (41)	9.0%
Affect businesses**	6.2% (35)	NA
Negative effect**	5.8% (33)	NA
Increase in value	1.6% (9)	13.0%
Dangerous**	1.6% (9)	NA
Other	3.0% (17)	3.0%
TOTAL	100.0% (567)	100.0% (496)

\* All Santa Fe, New Mexico responses are rounded to the nearest whole number and only the total N was available for comparison.

\*\* NA - Categories not included in the Santa Fe, New Mexico survey.

Clark County residents were asked under *what conditions* they would consider purchasing residential properties near HLW transport routes. Almost three-fourths of the respondents declared that they would not consider purchasing property along the transportation routes under any conditions (Table 8). These responses are more negative than those expressed by respondents in the earlier Santa Fe, New Mexico study.

**Table 8 Conditions under Which Residents Would Consider Purchasing Residential Property near a Highway to be used for the Shipment of HLW in Clark County**

Environmental Condition	Nevada Percent (N)	New Mexico Percent *
Under no condition	74.9% (355)	59.0%
Do not know	2.5% (12)	8.0%
Depends on location**	3.2% (15)	NA
Would consider conditions	3.6% (17)	19.0%
Depends on safety measures**	3.2% (15)	NA
Other	6.1% (29)	5.0%
Would Not Affect Decision to Purchase***	NA	9.0%
<b>TOTAL</b>	<b>100.0% (474)</b>	<b>100.0% (489)</b>

\* All Santa Fe, New Mexico responses are rounded to the nearest whole number and only the total N was available for comparison.

\*\* NA - Categories not included in the Santa Fe, New Mexico survey.

\*\*\* NA - Category not included in the Clark County, Nevada survey.

#### 4.4.3 Direction and Magnitude of Property Value Impacts on Residential Property

Clark County residents were asked whether residential property near a highway used for transporting HLW would sell for more, the same, or less, than an identical property that *is not near* such a route (Table 9). Eighty-two percent of the respondents believe such a property would sell for less; 15% think it would not make a difference; and only the remaining 3% believe it would sell for more. This pattern of response was similar to the earlier Santa Fe County, New Mexico study which found 71% of the respondents indicating that residential property would sell for less (ZIA Research Associates 1990).

**Table 9 Perceptions of Direction of Impact on Property Values**

Residential Property Near Nuclear Waste Shipment Routes would sell for...	Nevada Percentage (N)	New Mexico Percentage (N)*
More money	3.3% (13)	3.0%
Same amount of money	14.5% (57)	20.0%
Less money	82.2% (324)	71.0%
Not Sure**	NA	6.0%
<b>TOTAL</b>	<b>100.0% (394)</b>	<b>100.0% (501)</b>

\* All Santa Fe, New Mexico responses are rounded to the nearest whole number and only the total N was available.

\*\* NA - Categories not included in the Clark County, Nevada survey.

Respondents answering that a residential property would sell for *more/less* than a comparable property not near a shipment route were then asked how much more or less they would expect the price to be. Of the 369 Clark County respondents who expect lower selling prices for homes near shipment routes, the mean expected drop in selling price in Clark County is estimated at approximately 25% compared to identical homes not near a highway that transports high-level nuclear waste (Table 10).

**Table 10 The Amount of Diminution in Selling Price of Residential Properties Near a HLW Shipment Route Compared to an Identical Property Not Near Such a Route**

Amount of Diminution	Nevada		New Mexico	
	Percent (N)	Cumulative Percent*	Percent (N)**	Cumulative Percent**
Less than 1 percent	12.4% (47)			
1-5 percent	6.1% (23)	18.5%		
6-10 percent	10.3% (39)	28.8%	11.0%***	11.0%***
11-20 percent	18.9% (72)	47.7%	22.0%	33.0%
21-30 percent	17.6% (67)	65.3%	19.0%	52.0%
31-40 percent	8.2% (31)	73.5%	13.0%	65.0%
41-50 percent	12.4% (47)	85.9%	10.0%	75.0%
51-60 percent	2.9% (11)	88.8%	5.0%	80.0%
61-75 percent	1.8% (7)	90.6%	2.0%	82.0%
More than 75 percent	6.6% (25)	97.2%	6.0%	88.0%
Not sure/refused	2.9% (11)	100.1%	12.0% (357)	100.0%

\* Percents are rounded to the nearest tenth

\*\* All percents are rounded to the nearest whole number and only the total N is available for comparison.

\*\*\* The Santa Fe, New Mexico survey classification was Less Than Ten Percent.

When the 25.0% mean diminution rate reported by Clark County survey respondents is applied to all residential properties within one mile of the northern and western beltway routes suggested in the DEIS, the resulting diminution of assessed property values utilizing current assessed residential valuations is \$492.3 million (Table 11 and Map 1 and 2). Alternatively, since the beltway is not expected to be completed before HLW shipments are to commence, the application of the 25.0% mean property value diminution along the I-15 transportation corridor in Clark County could result in a loss of \$604.6 million of assessed residential valuation.



**Table 11 Application of Property Value Survey to Clark County Residential Assessed Valuation**

Clark County Property Value Survey	Nevada Transportation Corridor		
	Rate	Beltway	I-15
Residential at One Mile	25.0%	\$492,286,135	\$604,611,075

It is important to note that these ranges represent the application of the mean rate of property value diminution as reported by those Clark County residents who were surveyed to current residential assessed valuation within one mile of the beltway and I-15 routes through Clark County. These rates are based on the respondent's current perception of likely property value diminution and are based on current residential assessed valuation data. As noted in Section 3, perceptions are dynamic and thus are likely to change over time. In addition, the current assessed residential valuation within Clark County does not account for the significant developments that are proposed over the next decade especially along the northern beltway. Thus, these figures are best understood as representing the intensity of public concern about the effect of DOE's proposal to construct the Yucca Mountain repository and ship HLW through Clark County.

## **5.0 BANKERS AND APPRAISERS SURVEY**

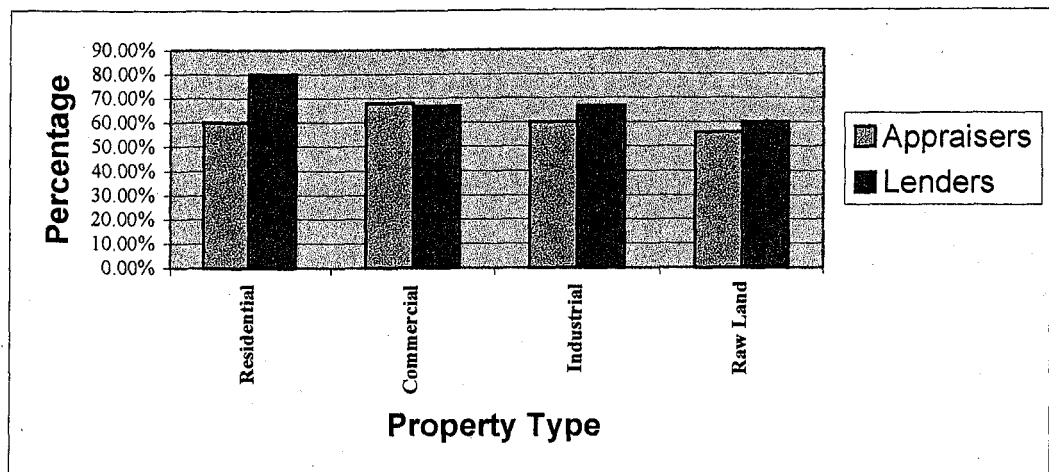
This section of the report summarizes the results of focused interviews with Clark County lenders and appraisers that is described in detail in the report, *Clark County Residents and Key Informant Surveys: Beliefs, Opinions, and Perceptions about Property Value Impacts from the Shipment of High-level Nuclear Waste through Clark County, Nevada*. The results are applied to the assessed valuation data for three groups of land uses within Clark County. A survey of 18 Clark County lenders and 35 certified appraisers was conducted by Urban Environmental Research in May of 2000.

The purpose of the survey was to identify the opinions and perceptions of lenders and appraisers regarding the potential effect on property values of the proposed shipments of HLW through Clark County under three scenarios and for three different types of land uses. In addition, the lenders and appraisers were asked to estimate potential property values at distances up to one mile along the transportation corridor and at distances of one to three miles. The results of the survey are summarized and then applied to residential, commercial, and industrial assessed valuation data for Clark County along two potential routes (see sections 5.1 – 5.4). The methodology for this application is discussed in Appendix C; the survey protocols are attached as Appendix D and E.

### **5.1 Demographics and Experience**

Of the lending institutions surveyed, 80% provide residential mortgages, while approximately 60 to 70% provide loans for commercial, industrial, and raw property (Fig. 7). In comparison, 60% of the appraisers conducted appraisals on residential properties, industrial and raw properties, and 68% conducted appraisals on commercial properties. Only 36% of those interviewed indicated any experience appraising casinos.

**Figure 7 Lenders and Appraisers Experience by Property Type**



The survey asked several questions about the range of experience of both professional populations. The bankers surveyed had an average of 10.4 years experience in Clark County and an average total experience of over 17 years, while the appraisers had an average of 14.3 years experience in Clark County and an average total experience of 19.9 years.

The bankers were queried about their institutions' lending policies on environmental contaminated properties. Eighty percent reported that their institutions have established formal lending policies concerning contaminated properties. Two-thirds of those who have established policies indicated that they would not lend on contaminated properties. Another one-third requires a property to pass a Phase 1 Environmental Assessment before a loan can be made. Forty-seven percent of the lenders surveyed regularly or sometimes ask appraisers to take into account the effect of any contamination when assessing property values. Another 40% of the banks indicated that they never do. Further, the majority of the bankers indicated that it was the responsibility of the seller to inform the bank of any environmental contamination.

Approximately one-half of the bankers and one-third of the appraisers knew of properties that had experienced 'residual property value loss attributable to the fact that at one time the property was contaminated.' Both the bankers and lenders revealed that most of their experience with the effects of environmental contamination on property values in Clark County resulted from underground storage tanks, asbestos removal from buildings, and to a more limited degree, commercial and industrial sites. They also indicated that if the property had been fully remediated, typically there were minimal, if any residual effects on property values. They did note, however, that at some sites, especially industrial areas, "earlier contamination, and continuing uncertainty has resulted in small stigma effects resulting in lower than expected values" (UER 2000).

In response to questions about which lending terms were likely to be adjusted if a property was identified as contaminated, more than one-half of the bankers and appraisers indicated that they would adjust Loan-to-Value-Ratio and/or the Risk Premium. In addition, two-thirds of the bankers stated that they also adjusted Interest Rates.

## **5.2 Property Value Impacts by Scenario**

The lenders and appraisers were then asked to estimate the potential impacts of transporting HLW on property values under three different scenarios, for three different property types, and at varying distances from the transportation corridor. The three scenarios ranged from a benign, no-incident scenario, to an event that results in no release of radiation, and finally, to a significant event resulting in the release of radiation to the environment. The descriptions of the properties evaluated are described in Appendix D and E.

### 5.2.1 Scenario 1

Under the first scenario, the appraisers and lenders were asked to evaluate whether there would be any changes in property values along the corridor if ‘no event’ occurred, but there was adverse publicity, particularly, at the onset of the shipment campaign. This scenario was assigned to three discrete residential, commercial, and industrial properties that were characterized in terms of size, location, lease fees, and other factors (Appendix D and E). As noted above, the lenders and appraisers were also asked to differentiate the level of impact, if any that might be experienced at two varying distances along the corridor. These distances were within 1 mile of the shipment route and within 1 to 3 miles of shipment routes.

According to the lenders and appraisers, residential properties would lose the most value in percentage terms. Appraisers indicated that within one mile of a shipment route, residential properties would decline on the average by 3.50%, while lenders indicated the decline would be approximately 2.00% (Table 12). When these rates of diminution are applied to residential **assessed valuation data** for these property types within one mile of the beltway route (Map 3), the potential property value loss for residential property ranges from \$39.4 million to \$68.9 million (Table 12). In contrast, if these rates are applied to the assessed property value data within one mile of the I-15 route (Map 3) then diminution could range from \$48.4 million to \$84.6 million (Table 13).

According to the appraisers and lenders, residential properties at a distance of one-to-three miles from the routes would continue to experience the greatest decline in value relative to the other two property types. When the rates of property value diminution are applied to residential assessed valuation data at a distance of one to three miles from the

beltway route, the diminution ranges from \$31.8 million to \$93 million. From the I-15 route, the diminution ranges from \$36.9 million to \$107.7 million (Map 3). Thus, under a “no event” scenario, lenders and appraisers indicated that the rate of residential property value diminution when applied to assessed valuation data along the beltway might be as high as \$71.2 million to \$161.9 million, while along the I-15 route it could go as high as \$85.2 million to \$192.3 million (Map 3).

**Table 12 Scenario 1 Mean Property Value Diminutions within 1 Mile and at 1 to 3 Miles of the Beltway Route**

Residential Property Value Diminution					
	1 mile		1 - 3 miles		Totals
Lenders (N*)	2.00% (11)	\$39,382,891	0.50% (11)	\$31,833,926	\$71,216,816
Lenders Std. Dev.	3.37		1.51		
Appraisers (N*)	3.50% (13)	\$68,920,059	1.46% (12)	\$92,955,063	\$161,875,121
Appraisers Std. Dev.	3.75		1.99		
Commercial Property Value Diminution					
	1 mile		1 - 3 miles		Totals
Lenders (N*)	0.56% (10)	\$156,610	0.56% (10)	\$1,808,744	\$1,965,355
Lenders Std. Dev.	1.58		1.58		
Appraisers (N*)	3.21% (14)	\$897,713	1.25% (14)	\$4,037,376	\$4,935,088
Appraisers Std. Dev.	5.50		2.55		
Industrial Property Value Diminution					
	1 mile		1 - 3 miles		Totals
Lenders (N*)	0.56% (10)	\$347,723	0.56% (10)	\$1,723,991	\$2,071,715
Lenders Std. Dev.	1.58		1.58		
Appraisers (N)*	1.25% (12)	\$776,168	0.83% (12)	\$2,555,202	\$3,331,370
Appraisers Std. Dev.	3.11		1.95		

When the rates of diminution suggested by the lenders are applied to all commercial properties within Clark County land use codes 335 (professional and

services), 338 (financial), and 385 (commercial condominiums), the diminution in assessed value totals almost \$2 million along the beltway route and \$4.9 million along the I-15 route (Map 3). Appraisers indicate that diminution effects for these same commercial property types would be \$4.9 million along the beltway route and \$8.6 million along I-15 route (Map 3).

**Table 13 Scenario 1 Mean Property Value Diminution within 1 Mile and at 1 to 3 Miles of the I-15 Route**

Residential Property Value Diminution					
	1 mile		1 - 3 miles		Totals
Lenders (N*)	2.00% (11)	\$48,368,886	0.50% (11)	\$36,879,691	\$85,248,577
Lenders Std. Dev.	3.37		1.51		
Appraisers (N*)	3.50% (13)	\$84,645,551	1.46% (12)	\$107,688,699	\$192,334,249
Appraisers Std. Dev.	3.75		1.99		
Commercial Property Value Diminution					
	1 mile		1 - 3 miles		Totals
Lenders (N*)	0.56% (10)	\$1,917,545	0.56% (10)	\$3,018,791	\$4,936,336
Lenders Std. Dev.	1.58		1.58		
Appraisers (N*)	3.21% (14)	\$4,280,234	1.25% (14)	\$4,474,279	\$8,574,513
Appraisers Std. Dev.	5.50		2.55		
Industrial Property Value Diminution					
	1 mile		1 - 3 miles		Totals
Lenders (N*)	0.56% (10)	\$2,479,014	0.56% (10)	\$5,006,845	\$7,485,860
Lenders Std. Dev.	1.58		1.58		
Appraisers (N*)	1.25% (12)	\$14,210,065	0.83% (12)	\$11,175,994	\$25,386,058
Appraisers Std. Dev.	3.11		1.95		

Similarly, when the diminution rates suggested by the lenders and appraisers are applied to industrial properties with the land use codes 240 (storage facilities), 250 (mini-warehouses), and 260 (industrial condos), the lenders' data indicates that industrial property values could experience diminution of \$2.1 million along the beltway route and

\$7.5 million along the I-15 route (Map 3). Applying the rates stated by the appraisers along these same routes, property value would diminish by \$3.3 million along the beltway route and \$25.4 million along the I-15 route (Map 3).

### 5.2.2. Scenario 2

Responses by bankers and appraisers demonstrate that property value diminution would increase substantially under transportation Scenario 2 (Table 14 and 15).

Appraisers and lenders indicated that residential property values would fall about 6 to 8% within one mile from the transportation route and up to 4% within one to three miles.

When these rates are applied to assessed valuation data, the total residential property diminution ranges from \$226.1 million to \$411.4 million along the Beltway Route and \$270.4 million to \$487.5 million along the I-15 Route (Table 14 and 15 and Map 3).

Applying the rates of diminution for commercial properties (professional and business, financial, and commercial condominium land uses) indicated by the appraisers and lenders under this scenario there would be losses ranging from \$4.3 million to \$11.9 million for commercial property value within three miles of the Beltway route (Map 3). When these rates are applied within three miles of the I-15 Route, the resulting decrease in the assessed valuation for commercial properties escalates to \$26.6 million to \$59.9 million (Map 3).

**Table 14 Scenario 2 Mean Property Value Diminutions within 1 Mile and at 1 to 3 Miles of the Beltway Route**

Residential Property Value Diminution					
	1 mile		1 - 3 miles		Totals
Lenders (N*)	6.18% (11)	\$121,693,133	1.64% (11)	\$104,415,276	\$226,108,408



Lenders Std. Dev.	5.13		3.23		
Appraisers (N*)	7.96% (13)	\$156,743,905	4.00% (13)	\$254,671,404	\$411,415,310
Appraisers Std. Dev.	5.81		4.77		
Commercial Property Value Diminution					
	1 mile		1 - 3 miles		Totals
Lenders (N*)	4.00% (10)	\$1,118,645	1.00% (10)	\$3,229,901	\$4,348,546
Lenders Std. Dev.	4.59		3.16		
Appraisers (N*)	7.39% (14)	\$2,066,697	3.04% (14)	\$9,818,898	\$11,885,595
Appraisers Std. Dev.	6.18		4.82		
Industrial Property Value Diminution					
	1 mile		1 - 3 miles		Totals
Lenders (N*)	4.00% (10)	\$2,483,738	1.00% (10)	3,078,556	\$5,562,294
Lenders Std. Dev.	4.59		3.16		
Appraisers (N*)	5.29% (12)	\$3,284,744	2.08% (12)	\$6,403,397	\$9,688,140
Appraisers Std. Dev.	6.13		3.96		

The appraisers and lenders indicated that the rate of property value diminution would be lower for industrial properties than for residential or commercial [(4.0% - 5.29% at one mile and 1.0% - 2.08% at one to three miles) Table 14 and 15]. When these rates are applied to the Beltway routes, the total property value decrease for the three industrial land uses examined was \$5.6 million to \$9.7 million along the Beltway Route and \$19.1 million to \$29.3 million along the I-15 Route (Map 3).

**Table 15 Scenario 2 Mean Property Value Diminution within 1 Mile and at 1 to 3 Miles of the I-15 Route**

<b>Residential Property Value Diminution</b>					
	<b>1 mile</b>		<b>1 - 3 miles</b>		<b>Totals</b>
Lenders (N*)	6.18% (11)	\$149,459,858	1.64% (11)	\$120,965,388	\$270,425,245

Lenders Std. Dev.	5.13		3.23		
Appraisers (N*)	7.96% (13)	\$192,508,166	4.00% (13)	\$295,037,531	\$487,545,697
Appraisers Std. Dev.	5.81		4.77		
Commercial Property Value Diminution					
	1 mile		1 - 3 miles		Totals
Lenders (N*)	4.00% (10)	\$17,707,246	1.00% (10)	\$8,940,795	\$26,648,041
Lenders Std. Dev.	4.59		3.16		
Appraisers (N*)	7.39% (14)	\$32,714,136	3.04% (14)	\$27,180,017	\$59,894,153
Appraisers Std. Dev.	6.18		4.82		
Industrial Property Value Diminution					
	1 mile		1 - 3 miles		Totals
Lenders (N*)	4.00% (10)	\$13,696,749	1.00% (10)	\$5,390,69801	\$19.087,447
Lenders Std. Dev.	4.59		3.16		
Appraisers (N*)	5.29% (12)	\$18,113,951	2.08% (12)	\$11,212,651	\$29,326,602
Appraisers Std. Dev.	6.13		3.96		

### 5.2.3 Scenario 3

Scenario 3 as described earlier in the report depicts an accident event and the consequences of the event that involves a truck releasing its radioactive waste content. Lenders and appraisers indicated a substantial property value diminution under Scenario 3 for all three types of property (Tables 16 and 17). Lenders and appraisers indicated that residential property values could drop approximately 30% at one mile. When these rates are applied to residential properties within three miles of the Beltway, the losses range from \$1.8 billion to \$2.2 billion (Map 3). When these rates of diminution are applied to the I-15 Route, there are losses of \$2.2 billion to \$2.6 billion.

**Table 16 Scenario 3 Mean Property Value Diminutions within 1 Mile and at 1 to 3 Miles of the Beltway Route**

<b>Residential Property Value Diminution</b>					
	<b>1 mile</b>		<b>1 - 3 miles</b>		<b>Totals</b>
<b>Lenders (N*)</b>	29.00% (9)	\$571,051,917	20.00% (5)	\$1,273,357,021	\$1,844,408,938

Lenders Std. Dev.	11.94		NA**		
Appraisers (N*)	33.79% (14)	\$665,373,940	23.65% (13)	\$1,505,744,677	\$2,171,118,617
Appraisers Std. Dev.	23.57		25.61		
Commercial Property Value Diminution					
	1 mile		1 - 3 miles		Totals
Lenders (N*)	22.00% (7)	\$6,152,549	16.67% (5)	\$53,842,411	\$59,994,990
Lenders Std. Dev.	5.70		11.55		
Appraisers (N*)	31.88% (16)	\$8,915,602	20.50% (15)	\$66,212,960	\$75,128,562
Appraisers Std. Dev.	23.83		25.34		
Industrial Property Value Diminution					
	1 mile		1 - 3 miles		Totals
Lenders (N*)	21.25% (6)	\$13,194,858	10.00% (4)	\$30,785,562	\$43,980,420
Lenders Std. Dev.	6.29		14.14		
Appraisers (N*)	25.54% (14)	\$15,858,667	16.73% (13)	\$51,504,245	\$67,362,912
Appraisers Std. Dev.	25.21		25.97		

Appraisers indicated that the potential property value loss for commercial property could be 32% or higher at one mile and 20.50% at one to three miles. Lenders indicated a potential property value loss of 22% at one mile and 16.67% at one to three miles. When these rates are applied to the three commercial properties examined (professional and business, financial, and commercial condominiums) within three miles of the Beltway Route, the resulting property value diminution ranges from \$60 million to \$75.1 million (Map 3). For the I-15 Route, the potential commercial property value loss escalates to \$246.4 million to \$324.4 million (Map 3).

**Table 17 Scenario 3 Mean Property Value Diminution within 1 Mile and at 1 to 3 Miles of the I-15 Route**

<b>Residential Property Value Diminution</b>					
	<b>1 mile</b>		<b>1 - 3 miles</b>		<b>Totals</b>
Lenders (N*)	29.00% (9)	\$701,348,847	20.00% (5)	\$1,475,187	\$2,176,536,502
Lenders Std. Dev.	11.94		NA**		

Appraisers (N*)	33.79% (14)	\$817,192,329	23.65% (13)	\$1,744,409,402	\$2,561,601,731
Appraisers Std. Dev.	23.57		25.61		
	Commercial Property Value Diminution				
	1 mile		1 - 3 miles		Totals
Lenders (N*)	22.00% (7)	\$97,389,851	16.67% (5)	\$149,043,053	\$246,432,903
Lenders Std. Dev.	5.70		11.55		
Appraisers (N*)	31.88% (16)	\$141,126,747	20.50% (15)	\$183,286,298	\$324,413,045
Appraisers Std. Dev.	23.83		25.34		
	Industrial Property Value Diminution				
	1 mile		1 - 3 miles		Totals
Lenders (N*)	21.25% (6)	\$72,763,980	10.00% (4)	\$53,906,976	\$126,670,956
Lenders Std. Dev.	6.29		14.14		
Appraisers (N*)	25.54% (14)	\$87,453,744	16.73% (13)	\$90,186,371	\$177,640,114
Appraisers Std. Dev.	25.21		25.97		

The appraisers and lenders indicated that industrial property value losses could range from 21.25% to 25.54% within one mile of the transportation routes and from 10.0% to 16.73% at one to three miles from the routes under scenario 3. When this is applied to the industrial assessed valuation within three miles of the Beltway Route, the losses range from \$44 million to \$67.4 million (Map 3). For the same industrial land uses along the I-15 Route, the potential property value diminution climbs to \$126.7 million to \$177.6 million (Map 3).

### 5.3 Findings Related to Lenders and Appraisers Evaluations under Three Scenarios

One important observation in the survey responses is the strong consistency in the estimates of property value changes provided by the two professional groups. For example, the largest difference in percent diminution of a property within the residential sector between the two groups is only 5.5%. It is significant that two different groups with strong expertise in the real estate market are so consistent in their estimations of likely

diminution effects for three different scenarios and for three different types of properties. It provides one check for internal validity and lends credibility to the results. It also provides an additional step in the process of triangulating findings from different methodologies and different groups.

What are the results? First, as the following tables show, even under Scenario 1, a no-event characterization, diminution will likely result in all three market segments of the economy — residential, commercial, and industrial (Table 18 and Table 19). The largest declines (\$85.2 million - \$192.3 million) will be experienced in the residential sector within one to three miles of the I-15 Routes (Map 3). The rate of decline is less for commercial and industrial properties than for residential properties, with greater losses along the I-15 corridor than along the Beltway. This is because the I-15 corridor is more fully built out than the Beltway, which has significant stretches that have yet to be developed. Since this study did not examine the potential impact of the DOE's proposal to ship HLW on undeveloped lands, the potential property losses suggested by the experts are viewed as ranges of potential property value diminution for specific property types along the proposed routes. Additional work will be needed to complete and refine these ranges for the full gamut of property types before a direct comparison is possible between the routes.

**Table 18 Property Value Diminutions under Three Scenarios within 3-Mile Distance of the Proposed Beltway Route**

Groups	Residential		Commercial		Industrial	
	Lenders	Appraisers	Lenders	Appraisers	Lenders	Appraisers
<b>Scenario 1</b>	\$71,126,816	\$161,875,121	\$1,965,355	\$4,935,088	\$2,071,715	\$3,331,370
<b>Scenario 2</b>	\$226,108,408	\$411,415,310	\$4,348,546	\$11,855,595	\$5,562,294	\$9,688,140

<b>Scenario 3</b>	\$1,844,408,938	\$2,171,118,617	\$59,994,990	\$66,212,960	\$43,980,420	\$67,362,912
-------------------	-----------------	-----------------	--------------	--------------	--------------	--------------

What these figures suggest, however, is that among those most experienced with estimating Clark County property values, there is a perception that significant adverse impacts will occur along either of the Clark County routes proposed, for all property types examined, even under the most benign scenario.

**Table 19 Property Value Diminutions under Three Scenarios within 3-Miles of the I-15 Shipment Route, by Professional Group**

<b>Groups</b>	<b>Residential</b>		<b>Commercial</b>		<b>Industrial</b>	
	<b>Lenders</b>	<b>Appraisers</b>	<b>Lenders</b>	<b>Appraisers</b>	<b>Lenders</b>	<b>Appraisers</b>
<b>Scenario 1</b>	\$85,248,577	\$192,334,249	\$7,485,860	\$25,386,058	\$4,936,336	\$8,754,513
<b>Scenario 2</b>	\$270,425,245	\$487,545,697	\$26,648,041	\$59,894,153	\$19,087,447	\$29,326,602
<b>Scenario 3</b>	\$2,176,536,502	\$2,561,601,731	\$246,432,903	\$324,413,046	\$126,670,956	\$177,640,114

The findings also indicate that increasing the severity of events within the scenarios, as illustrated in Scenario 2 and 3, results in significantly larger rates of impact. Under Scenario 3, the most serious accident event evaluated, residential property diminution rises to \$1.8 billion - \$2.2 billion within 3 miles of the Beltway Route and \$2.2 billion - \$2.6 billion within 3 miles of the I-15 Route (Map 3).

## **6.0 Discussion of Community Impacts**

This section examines the application of the lenders' and appraisers' survey to specific jurisdictions within Clark County. Both the I-15 and Beltway routes are compared for the cities of Las Vegas and North Las Vegas, and for unincorporated Clark County. Since both routes utilize I-15 through Mesquite and Henderson, the impacts are discussed solely for this route for both of these cities.

### **6.1 Range of Potential Property Value Impacts for Las Vegas**

The City of Las Vegas is the largest jurisdiction within Clark County. Thus, it is reasonable to expect that the largest potential dollar decrease in property values would be experienced in this jurisdiction. According to the lenders and appraisers, residential properties within the City of Las Vegas, like all other jurisdictions within Clark County, are likely to experience the largest loss in property values along both the I-15 Route and the Beltway Route (Table 20). Applying the rates of diminution postulated by the lenders and appraisers, diminution of value of residential property, even without an incident of any type, could range from \$31.7 million to \$71.8 million along the Beltway Route and from \$54.9 million to \$119.2 million along the I-15 Route (Map 4).

Property value diminution for commercial properties is also significantly higher under Scenario 1 along the I-15 Route (\$4.6 million - \$17.2 million) than along the Beltway Route (\$1.1 million - \$2.4 million) (Table 20 and Map 4). Similar patterns of diminution, although at substantially lower levels, are indicated for industrial properties (Table 20).

**Table 20 Total Property Value Diminutions by Route, Property Type, Scenario, and Professional Group for Las Vegas**

	Beltway Route		I-15 Route	
Residential	Lenders	Appraisers	Lenders	Appraisers
Scenario 1	\$31,689,373	\$71,817,187	\$54,874,518	\$119,150,750
Scenario 2	\$100,577,042	\$182,337,680	\$173,316,846	\$297,839,714
Scenario 3	\$816,077,097	\$960,562,585	\$1,299,585,454	\$1,527,937,523
Commercial				
Scenario 1	\$1,063,232	\$2,440,448	\$4,633,047	\$17,209,885
Scenario 2	\$2,01,428	\$5,920,890	\$18,785,945	\$40,394,165
Scenario 3	\$31,832,781	\$39,311,841	\$156,593,356	\$209,480,593
Industrial				
Scenario 1	\$17,921	\$26,561	\$741,142	\$1,326,228
Scenario 2	\$32,001	\$66,562	\$2,950,247	\$4,493,467
Scenario 3	\$320,012	\$535,380	\$19,335,102	\$26,918,928

Since the assessed valuation for all three property types analyzed are significantly higher along the I-15 Route than the Beltway Route in Las Vegas, the dollar loss in assessed property values that results from applying the rates of diminution indicated by the lenders and appraisers is consistently higher along the I-15 Route than the Beltway Route for all three scenarios. Under Scenario 2, the losses along the I-15 Route could range from \$173.3 million to \$297.8 million for residential properties; to \$18.8 million to \$40.4 million for commercial properties; and \$3.0 to \$4.5 million for industrial properties (Map 4). Under the same scenario, the losses along the Beltway could range from \$100.6 million to \$182.3 million for residential properties; to \$2.0 million to \$5.9 million for



commercial properties; and approximately \$300 thousand to \$500 thousand for industrial facilities (Map 4).

Under Scenario 3, a HLW truck is involved in a serious accident. This event dramatically increases the level of potential property value diminution for all property types along both the I-15 Route and the Beltway Route. The pattern of distribution by route and property type remains the same as under Scenarios 1 and 2. The biggest drop is for residential property along the I-15 Route, where a \$1.3 billion to \$1.5 billion drop is estimated using the rates of diminution indicated by the lenders and appraisers (Map 4). Along the Beltway Route, the drop ranges from approximately \$816 million to \$961 million for residential properties (Map 4).

The assessed commercial property value losses could range from \$157 million to \$209 million along the I-15 Route (Map 4). Along the Beltway Route, the drop in assessed value for commercial property would be substantially lower than the I-15 Route, ranging from \$32 million to \$39 million (Map 4). The decrease in assessed valuation for industrial properties ranges from \$19.3 million to \$27 million along the I-15 Route and from \$320 thousand to \$535 thousand along the Beltway Route through the City of Las Vegas (Map 4).

When analyzing the results it is important to keep in mind that the I-15 Route represents the heart of existing Las Vegas development. Thus, this area is largely built out and currently is a major contributor to the well being of not only the City of Las Vegas and Clark County, but also the State of Nevada. Lenders and appraisers repeatedly remarked that the future economic growth of the area is inextricably linked to the development of the Northern and Western Beltway, i.e., the Beltway Route. Thus, while property value impacts may be lower today along the Beltway, it is expected to play a

major role in the Valley's future development (see Las Vegas Governmental Fiscal Impact Report). If the DOE selects the Beltway as its preferred route, as it has suggested in the DEIS, then the future economic growth of Las Vegas and in fact the entire Valley may be diminished.

## **6.2 Range of Potential Property Value Impacts for North Las Vegas**

In North Las Vegas, under all three Scenarios, the largest property value losses occur along the I-15 Route just as in Las Vegas (Table 21). In addition, like Las Vegas, the largest drop in assessed property value occurs for residential properties. Under Scenario 1, the decrease could reach \$6.3 million to \$15.2 million along the I-15 Route and \$2.8 million to \$7.9 million along the Beltway Route (Map 5). The loss of assessed residential valuation rises to \$20.2 million to \$40 million under Scenario 2 along the I-15 Route and \$9 million to \$22 million along the Beltway Route (Map 5). Potential residential property value losses grow significantly under Scenario 3 to \$183 million to \$215 million along the I-15 Route and \$107 million to \$127 million along the Beltway Route (Map 5).

The pattern of distribution of impacts for commercial and industrial properties varies in North Las Vegas from those found in Las Vegas. In North Las Vegas, the assessed valuation for industrial properties is much higher than for commercial properties. This finding is the reverse of the finding for Las Vegas. Losses in assessed valuation for industrial properties range from \$1.3 million to \$2.5 million under Scenario 1; to \$5.7 million to \$8.5 million under Scenario 2; to \$36.4 to \$49.9 million under Scenario 3 along the I-15 Route (Map 5). The range of industrial property value loss along the Beltway Route ranges from \$245 thousand to \$364 thousand under Scenario 1; \$438 thousand to

\$911 thousand under Scenario 2; and \$4.4 million to \$7.3 million under Scenario 3 (Map 5).

**Table 21 Total Property Value Diminutions by Route, Property Type, Scenario, and Professional Group for North Las Vegas**

	<b>Beltway Route</b>		<b>I-15 Route</b>	
<b>Residential</b>	<b>Lenders</b>	<b>Appraisers</b>	<b>Lenders</b>	<b>Appraisers</b>
<b>Scenario 1</b>	\$2,750,828	\$7,895,167	\$6,329,432	\$15,242,170
<b>Scenario 2</b>	\$9,00,427	\$21,535,044	\$20,234,422	\$39,503,934
<b>Scenario 3</b>	\$107,041,756	\$126,547,402	\$182,566,875	\$215,189,609
<b>Commercial</b>				
<b>Scenario 1</b>	\$19,843	\$44,293	\$309,167	\$1,153,399
<b>Scenario 2</b>	\$35,435	\$107,721	\$1,261,208	\$2,706,564
<b>Scenario 3</b>	\$590,696	\$726,411	\$10,463,116	\$14,007,664
<b>Industrial</b>				
<b>Scenario 1</b>	\$245,372	\$363,677	\$1,343,093	\$2,455,732
<b>Scenario 2</b>	\$438,165	\$911,383	\$5,720,359	\$8,543,148
<b>Scenario 3</b>	\$4,381,649	\$7,330,499	\$36,441,222	\$49,880,442

When the rates of property value diminution indicated by the lenders and appraisers surveyed are applied to commercial property values along the Beltway Route, the decrease in assessed valuation ranges from less than \$20,000 to \$107,000 under Scenarios 1 and 2 (Map 5). With a significant accident, as described in Scenario 3, commercial property values decrease by \$591 thousand to \$726 thousand (Map 5). Along the I-15 Route in North Las Vegas, commercial property value diminution ranges from

\$309 thousand to \$1.2 million under Scenario 1 and \$1.3 million to \$2.7 million under Scenario 2 (Map 5). Under Scenario 3, commercial property value diminution mushrooms to \$10.5 million - \$14 million along the I-15 route in North Las Vegas (Map 5).

Again, as in Las Vegas, when comparing the impacts between the Beltway and I-15, it is important to recognize that the I-15 Route is virtually built out while the Beltway Route is linked to future economic growth. Further, this study only examined a handful of land uses and so the level of impacts described represent only diminution for those types of property. Thus, the numbers presented in this report do not reflect losses that may be experienced by properties that are yet undeveloped. Additional studies will need to be done to more completely understand the full range of impacts that may be experienced along both the I-15 Route and Beltway Route.

### **6.3 Range of Potential Property Value Impacts for Unincorporated Clark County**

A large number of Clark County residents live within unincorporated Clark County. When the survey results from the Clark County lenders and appraisers survey is applied to the assessed valuations for the three property types evaluated in unincorporated Clark County, the greatest losses for commercial and industrial properties occur along the I-15 Route similarly to what is found in Las Vegas and Clark County as a whole. Commercial property value diminution ranges from: \$2.5 million - \$6.7 million under Scenario 1; \$6.2 million - \$15.9 million under Scenario 2; and \$76.2 million - \$96.6 million under Scenario 3 along the I-15 Route (Map 6). For the same type of property, along the Beltway Route, the losses range from: \$789 thousand - \$2.1 million under Scenario 1; \$1.2 - \$5.0 under Scenario 2; and \$24.4 million - \$30.7 million under

Scenario 3 (Map 6). Industrial property values along both the I-15 Route and Beltway Route follow a similar pattern as commercial properties as is illustrated in Table 22.

**Table 22 Total Property Value Diminutions by Route, Property Type, Scenario, and Professional Group for Unincorporated Clark County**

	Beltway Route		I-15 Route	
Residential	Lenders	Appraisers	Lenders	Appraisers
Scenario 1	\$33,852,368	\$76,319,267	\$21,143,886	\$52,166,467
Scenario 2	\$107,377,106	\$193,409,387	\$67,797,247	\$136,256,906
Scenario 3	\$863,063,950	\$1,051,735,024	\$637,098,310	\$751,312,864
Commercial				
Scenario 1	\$789,352	\$2,080,298	\$2,450,718	\$6,652,723
Scenario 2	\$1,200,313	\$4,991,596	\$6,186,033	\$15,928,036
Scenario 3	\$24,363,023	\$30,744,289	\$76,167,943	\$96,578,768
Industrial				
Scenario 1	\$1,653,819	\$2,690,728	\$2,697,498	\$4,722,149
Scenario 2	\$4,664,186	\$7,973,460	\$9,988,899	\$15,553,252
Scenario 3	\$35,948,502	\$54,432,301	\$67,564,375	\$95,776,012

Residential properties in unincorporated Clark County vary from the pattern in Las Vegas and Clark County as a whole. In unincorporated Clark County the larger property value losses are found along the Beltway, when one applies the results of the lenders and appraisers survey to assessed residential valuation. Along the Beltway Route, the losses could range from \$33.9 million - \$76.3 million under Scenario 1 and \$107.4 million - \$193.4 million under Scenario 2 (Map 6). Along this same route, the losses rise to \$863

million to \$1.1 billion, under Scenario 3 (Map 6). In contrast, they range from \$21.1 - \$52.2 million under Scenario 1; \$67.8 million - \$136.3 million under Scenario 3; and \$637.1 million - \$751.3 million under Scenario 3 (Map 6).

#### **6.4 Range of Potential Property Value Impacts for Henderson**

Both routes evaluated in this paper utilize I-15 through Henderson, and as a result require that only one set of potential property values be discussed. In addition, since most of Henderson lies outside of the three-mile corridor along the route that was studied, the range of potential property value impacts to Henderson are significantly less than for the other communities that have been examined. In fact, the Clark County assessed valuation data used in this study does not indicate any commercial property within three miles of I-15 in Henderson. Therefore, the results of the lenders and appraisers' survey are applied only to residential and industrial properties (Table 23).

In Henderson, the potential impacts are larger for commercial properties than for residential properties. Again, this is because most of the residential development is outside of the three-mile corridor along I-15 that was investigated. The ranges of potential commercial property value losses were: \$98 thousand - \$145 thousand under Scenario 1; \$175 thousand - \$364 thousand under Scenario 2; and \$ 1.7 million - \$2.9 million under Scenario 3 (Map 7).

For residential properties in Henderson, the decrease in assessed valuation ranged from: \$38 thousand - \$104 thousand under Scenario 1; \$123 thousand - \$281 thousand under Scenario 2; and \$1.4 million - \$1.6 million under Scenario 3 (Map 7).

It is important to note that Henderson recently annexed property within the three-mile corridor that is largely undeveloped. The DOE's proposal to ship HLW may reduce

both the extent of future development along the I-15 corridor as well as the value of future developments. As mentioned earlier in the discussion of North Las Vegas, this study did not examine undeveloped lands. Given the nature of the land use within the three-mile corridor in Henderson, the level of impacts discussed in this section may significantly understate the potential property value loss. Future efforts should examine the impacts of the DOE's proposed shipment campaign on other types of land uses, especially the vast amounts of undeveloped property within Henderson and the rest of Clark County.

**Table 23 Total Property Value Diminutions by Route, Property Type, Scenario, and Professional Group for Henderson**

	<b>I-15 Route</b>	
<b>Residential</b>	<b>Lenders</b>	<b>Appraisers</b>
<b>Scenario 1</b>	\$37,969	\$104,136
<b>Scenario 2</b>	\$123,444	\$280,617
<b>Scenario 3</b>	\$1,372,013	\$1,620,959
<b>Industrial</b>		
<b>Scenario 1</b>	\$97,906	\$145,111
<b>Scenario 2</b>	\$174,832	\$363,651
<b>Scenario 3</b>	\$1,748,323	\$2,924,944

## 6.5 Range of Potential Property Value Impacts for Mesquite

Like Henderson, I-15 is used for both alternative routes examined through Mesquite. Thus, the results of the lenders and appraisers survey are applied only along this one route in Mesquite. In contrast to Henderson, virtually all of Mesquite falls within the three-mile corridor along I-15. The pattern of property value diminution within Mesquite like Clark County as whole and the City of Las Vegas is highest for residential

property followed by commercial and then industrial property (Table 24).

**Table 24 Total Property Value Diminutions by Route, Property Type, Scenario, and Professional Group for Mesquite**

<b>I-15 Route</b>		
<b>Residential</b>	<b>Lenders</b>	<b>Appraisers</b>
<b>Scenario 1</b>	\$2,886,279	\$5,739,365
<b>Scenario 2</b>	\$9,030,389	\$13,852,581
<b>Scenario 3</b>	\$56,854,123	\$66,652,647
<b>Commercial</b>		
<b>Scenario 1</b>	\$92,928	\$370,051
<b>Scenario 2</b>	\$414,855	\$865,388
<b>Scenario 3</b>	\$3,208,489	\$4,346,021
<b>Industrial</b>		
<b>Scenario 1</b>	\$56,697	\$105,294
<b>Scenario 2</b>	\$253,110	\$373,083
<b>Scenario 3</b>	\$1,581,934	\$2,139,788

Under Scenario 1, where no incident occurs, the loss in assessed valuation for residential property ranges from \$2.9 million - \$5.7 million (Map 8). Under Scenario 2, where an incident occurs, but where there is no release of radiation, the level of impact increases significantly. Under this scenario, the residential assessed valuation could decrease by \$9.1 million - \$13.9 million and under Scenario 3 the drop rises to \$56.9 million - \$66.7 million (Map 8). The potential diminution for commercial property ranges from under \$100 thousand - \$370 thousand under Scenario 1 but jumps to between \$415 thousand and \$865 thousand under Scenario 2 (Map 8). In the event of a serious accident,



as described in Scenario 3, the diminution in assessed valuation indicated by both types of experts, lenders and appraisers, for all three-property types are devastating. Under this scenario, the rate of diminution could be as high as \$3.2 million - \$4.3 million for commercial property and \$1.6 - \$2.1 for industrial property (Map 8).

## **Chapter 7.0 Comparison and Evaluation of Findings and Discussion of Implications**

### **7.1 Comparison of Findings**

The findings from this research using three distinct methodologies – a review of analogous case experience; a survey of residents who live in the potentially affected area; and a survey of experts. The experts are lenders and appraisers who have experience with stigma-induced property value diminution and who daily make decisions based on their knowledge of the factors that influence property values in Clark County. The findings all support the thesis that property values are likely to be adversely affected if the DOE's ships HLW through Clark County to Yucca Mountain.

The literature indicates that both physical and cognitive factors interact in a dynamic fashion that changes over time and distance. When one examines each of the discrete factors that have been shown to influence the extent of stigma-induced property in relationship to the DOE's proposal to ship HLW for over thirty years along the major transportation routes through Clark County, each factor points to an increased risk of property value diminution. Among the physical factors supporting the contention that property values may be adversely affected are:

- The type of hazard
- Magnitude of the shipping campaign
- The duration of the campaign, and
- Factors related to distances.

Numerous studies have indicated that the most adverse connotations are associated with all things *nuclear*, including the transport of HLW. In fact, when Clark County residents were asked the "effects of different environmental conditions on perceived residential property values," 86.3% indicated that residential property values would

decline along a highway used to transport nuclear waste (Table 6). For over a decade, surveys in the State of Nevada have indicated that by large majorities the public opposes both the construction of the Yucca Mountain repository and the related shipment of HLW through their communities. Given the consistency of the decade long opposition by Nevadans to the DOE's activities, it is unlikely that Clark County residents will fundamentally change their orientation related to this project. Further, national polls, even the most recent Associated Press national survey of public attitudes toward nuclear power indicated that even in the midst of an energy crisis that a large majority of Americans find it unacceptable to site nuclear facilities close to residential areas. Thus, it should be *anticipated* that the shipment of HLW will have an adverse impact on property values along the transportation routes.

In addition, the *magnitude* of the campaign in both *size* and *duration* are unprecedented. If the limited two year effort from 1994 to 1996 to ship radioactive waste through South Carolina resulted in property value diminution, it is only reasonable to expect that a campaign that may require as many as *93,000 truck shipments* and lasting for greater than *thirty years* could potentially result in property value diminution. Further, while the largest property value losses have been found in the areas closest to a negative environmental event or facility, the literature indicates that a number of factors influence the rate at which diminution decreases with *distance*. In Clark County, much of the core of the entire transportation network falls within three-miles of either of the two major routes being considered. When Clark County lenders and appraisers were surveyed as to their opinions, perceptions, and beliefs about the affects of transporting HLW on property values, they indicated that the rate of property value diminution would be highest nearest

the transportation route for HLW, for all three types of land uses examined (Table 18 – 19). This finding is consistent with the actual experiences documented in the literature.

Among the cognitive factors that have been shown to influence the extent of stigma-induced property value diminution are:

- Knowledge
- Perception, and
- Values

The literature clearly indicates that *knowledge* of an undesirable environmental condition is closely associated with declines in property values. The surveys of Clark County residents reported on in Section 4.0 show that 77% of Clark County residents are familiar with the DOE's plans. This finding is consistent with earlier surveys conducted for over a decade. The media amplification that is sure to accompany any final decision to construct the repository and the transport of HLW will certainly maintain if not increase public awareness of this issue.

*Perception*, especially the perception of risk, also has been positively correlated with property value diminution. When Clark County residents were asked about their perception of what will happen to residential property values if the DOE proceeds with its plans, over 80% indicated the effects in negative terms and almost two-thirds described the impacts on commercial properties in similar negative terms. Moreover, two expert groups, Clark County lenders and appraisers, who have on average over a decade of experience in Clark County determining property values also overwhelming indicated that property values are likely to suffer as a result of the DOE's proposed actions (Tables 22 – 24).

In fact, even under the most benign scenario where no incident of any type occurs, they projected that residential properties would decline by 2.00% - 3.50%, resulting in losses of \$85.2 million - \$192.3 million along the I-15 Route and \$71.1 million - \$162.0 million along the Beltway route. These experts indicate that if an event were to occur, even with no release of radioactive material that the rate of residential property value diminution would increase to 6% to 8% within one mile and 1.64% - 4.00% within one to three miles. This to is consistent with actual experience that has demonstrated that *distance* is associated with the rate of diminution with the largest drops occurring closest to the undesirable environmental condition.

When one considers the findings from the lenders and appraisers for the most severe accident event studies, Scenario 3, the level of diminution indicated is substantially higher than for the other two scenarios. Under this scenario, lenders and appraisers indicate that residential property losses would likely reach approximately thirty percent. This is consistent with findings in the literature that show that the increasing *magnitude* of an event influences the degree of property value diminution.

The experts, as well as, the public also found that commercial properties would be adversely affected although to a lesser extent than residential property. This is also consistent with what has been demonstrated with other stigma-induced property value declines.

Actual experience has also shown that *values* influence stigma-induced property value diminution. When one compares the rates of diminution stated by Clark County residents with those indicated by the experts and actual experience, there are variations shown that Reichert compared a number of studies of landfills from across the country and found that the actual level of diminution averaged around 12.5% with a standard

deviation of only 3.5% (Section 3). The Clark County residents surveyed indicated on average that they expect a 25% drop in residential property values. This rate of diminution is consistent with an earlier survey of residents in Santa Fe, New Mexico along the transportation corridor for waste shipments to WIPP. This rate of diminution is substantially higher than what has been demonstrated around landfills, and is remarkably close to the level of diminution indicated as likely by the experts under Scenario 3.

Differences between actual experience and public opinion surveys have been widely debated in the literature. Researchers such as Clark and Metz have argued that public opinion surveys are not useful in predicting actual behavior. Furby et al, have rebutted this criticism, arguing that the public incorporates multiple social, psychological, cultural, economic, and environmental factors into their concept of values that goes beyond the economic definitions of “fair market value” embraced by the experts. The findings from this research supports the arguments postulated by Furby et al. Further, work done by Slovic et al; have repeatedly found that the general public links all things “nuclear” with potential catastrophic accident events.

If this finding is correct, the residents’ survey responses are most associated with the expert’s responses to Scenario 3. Thus, while personal *value* systems may vary from economic definitions, this research indicates a consistent positive correlation in the direction of the survey findings with actual experience documented in the literature.

## **7.2 Evaluating the Results**

As discussed in Section 3.0, assessing property value diminution from negative environmental conditions is a complex and difficult task. As has been shown, multiple physical and cognitive factors interact in ways that are dynamic and changing over time.

Discerning the extent of potential property value diminution resulting from the DOE's proposal to ship HLW through Clark County to a repository at Yucca Mountain, presents an even greater challenge than measuring most other types of stigma-induced property value diminution. This difficulty is the result of the vast uncertainties associated with the DOE's proposal and the lack of experience with campaigns of the magnitude proposed. However, an evaluation of the findings from this research makes a compelling case that if the DOE proceeds with its plans to ship HLW through Clark County that property values will likely be adversely impacted at a significant level.

Assuming the case has been made that property value diminution is likely to occur along the route selected to ship HLW through Clark County, what is the best estimation that can be made as to the rate of administration? While there is no direct analogous case, actual experience at landfill sites support a rate of residential property value decline of 12.5% within one mile.

This level is significantly above the range estimated by Clark County lenders and appraisers under Scenario 1 (\$71.1 million - \$161.9 million) and Scenario 2 (\$226.1 million - \$411.4 million), but less than under Scenario 3.

The DEIS argues that there will be no event of any kind during the shipment period. This would be consistent with the level of losses indicated by the experts under Scenario 1. Thus, Scenario 1 appears to be an appropriate lower boundary for the level of impact that may be experienced. Using Scenario 1 as the lower boundary, means that at a minimum property value diminution is like to range from \$75.2 million to \$226.5 million.

Several factor support the selection of Scenario 2 as a reasonable upper bound for what can be expected. These factors include the strong public aversion that has been shown in repeated surveys for over a decade. The magnitude and duration of the shipping

campaign being proposed, is unprecedented. Even the much smaller shipment campaign of transuranic waste to New Mexico, already has resulted in incidents. For example, a truck has broken down on route to Carlsbad and another truck mistakenly wound up in Albuquerque, New Mexico. In addition, Clark County is ranked as the fastest growing county in the nation. This growth has led to increasing congestion along the transportation routes being considered. This in turn increases the likelihood of an incident. Most importantly, the rate of diminution projected by the lenders and appraisers under Scenario 2 is significantly lower than both what has been shown in the literature and what has been estimated by Clark County residents. The rate of diminution indicated by Clark County lenders and appraisers under Scenario 2 would mean total assessed property value diminution may range from \$236.0 million to \$433.2 million if the Beltway Route is selected and \$316.2 to \$576.8 million if the I-15 Route is selected. Thus, Scenario 2 is a conservative upper boundary for the level of diminution that is likely to occur.

### **7.3 Implications of the Research**

This study represents an initial assessment of the property value diminution that may occur as a result of DOE's proposal to construct the Yucca Mountain repository if it proceeds to ship HLW through Clark County.

It is important to remember that this study did not look at the full range of land uses in Clark County. In fact, while all residential property was included, only a limited number of commercial and industrial land uses were considered. Of particular note, this study did not address the many land uses associated with Clark County's dominant economic sector, tourism (Map 8).



This study also did not examine the large number of parcels that are yet undeveloped (Map 8). Land uses associated with tourism and undeveloped parcels represent an important component of Clark County's current economic base and its future. The impacts of DOE's proposal on these land uses must be examined to get a fuller understanding of the extent of property value diminution that may be experienced.

A next step in determining the potential impact to Clark County government should include expanding the types of land uses to be analyzed and investigating what these projected rates of assessed property value declines would mean for governmental services

It is important to note that this study presents the potential assessed property value damage, which represents only 35% of actual "fair market value." Understanding the range of assessed property value loss is an important first step to understanding what impact the DOE's proposed shipment campaign may have on government services.

Property tax rates are applied to the assessed valuation to generate revenue for government services. Either if assessed valuations decline, then property tax rates must go up, or service levels need to be reduced.

From the private property owner's perspective, these projected rates of diminution imply that there will likely be a loss of personal wealth and either increased property tax rates and/or reduced governmental services, even if the shipment of HLW occurs without an incident of any type. If an incident occurs, and there is a release of radioactive material, the diminution could be devastating.

As this study has shown, the extent of property value diminution varies by land use and route. This has important implications. If the I-15 route were selected, the total impact would likely be highest using the current value of developed land. This is because

the area is almost fully developed, however, in Las Vegas; there is already a greater impact on residential properties along the Beltway. The Beltway has also been identified as critical to future economic growth within the Las Vegas Valley. The DOE's selection of a route for shipping HLW has very significant consequences that vary by land use and jurisdiction.

In conclusion, the Yucca Mountain transportation project program, even under the DOE's own scenario that postulates no *incidents of any type*, will likely result in significant property value losses within Clark County.

This research supports the thesis that property values are likely to be affected adversely by the DOE's proposed actions. Further, while it may be impossible to estimate with precision, the exact extent of diminution, there is ample evidence that it will be significant.

## References

American Institute of Real Estate Appraisers. The Appraisal of Real Estate. Schaumburg, IL, American Institute of Real Estate Appraisers.

Blomquist, G. (1974). "The Effect of Electrical Utility Power Plant Location on Area Property Value." Land Economics (February): 97-100.

Carroll, T., T. Clauterite, et al. (1996). "The Economic Impact of a Transient Hazard on Property Values: The 1988 PEPCON Explosion in Henderson, Nevada." Journal of Real Estate Finance and Economics 13: 143-167.

Chalmers, J. A., and S. A. Roehr (1993). "Issues in the Valuation of Contaminated Property." The Appraisal Journal 61(1): 28-41.

Chalmers, J. A. and T. O. Jackson (1996). "Risk Factors in the Appraisal of Contaminated Property." The Appraisal Journal 64(1): 44-58.

Colwell, P. F. (1990). "Power Lines and Land Value." The Journal of Real Estate Research 5(1): 117-126.

Conway, S. (1990). Improving the Superfund Process. Superfund 90, Washington, DC.

Crawford, C. O. (1955). "Appraising Damages to Land from Power Line Easements." The Appraisal Journal (July): 367-378.

Cross, J. A. (1985). Residents' Awareness of The Coastal Flood Hazard: Lower Florida Keys Case Study. Boulder, CO, Institute of Behavioral Science, University of Colorado: 73-88.

Dunmire, T. D. (1992). "Real Estate Tax Valuations: Factoring in Environmental Impacts." Environmental Finance: 461-472.

Egar, F. J. (1973). Air Pollution and Property Values in the Hartford Metropolitan Region. New York, NY, Fordham University.

Flynn, J., C. K. Mertz et al. (1997). Results of a 1997 National Nuclear Waste Transportation Study. Eugene, OR, Decision Research.

Furby, L., and R. Gregory, P. Slovic, and B. Fischhoff. 1988. "Electric Power Transmission Lines, Property Values, and Compensation." Journal of Environmental Management. 27: 69-83.

Gamble, H. B. and R. Downing (1982). "Effects of Nuclear Power Plants on Residential Property Values." Journal of Regional Science 22: 457-478.

Gawande, K., and H. Jenkins-Smith (1999). "Nuclear Waste Transportation and Residential Property Values: Estimating the Effects of Transient Perceived Risks."

Gladstone, R. A. (1991). "Contaminated Property: A Valuation Perspective." Toxics Law Reporter (November): 798-802.

Greenberg, M. and J. Hughes (1992). "The Impact of Hazardous Waste Superfund Sites on the Value of Houses Sold in New Jersey." The Annals of Regional Science 26: 147-153.

Harrison, D., and D. L. Rubinfeld (1978). "Hedonic Housing Prices and the Demands for Clean Air." Journal of Environmental Economics and Management 5: 81-102.

Havlicek, J. J., R. Richardson, et al. (1972). Measuring the Impacts of Solid Waste Disposal Site Locations on Property Values. Chicago, IL, University of Chicago.

Healy, P. R., and J. J. H. Jr. (1992). "Lenders' Perspectives on Environmental Issues." The Appraisal Journal (July): 394-398.

Hohenemser, R. W. Kates, et al. (1983).

Jones, R. E., and R. E. Dunlap (1992). "The Social Bases of Environmental Concern: Have They Changed Over Time." Rural Sociology 54: 28-47.

Ketkar, K. (1992). "Hazardous Waste Sites and Property Values in the State of New Jersey." Applied Economics 24: 647-659.

Kiel, K. A., and K. T. McClain (1995). "The Effect of an Incinerator Siting on Housing Appreciation Rates." Journal of Urban Economics 37: 311-323.

Kiel, K. A., and K. T. McClain (1995). "House Prices During Siting Decision Stages: The Case of an Incinerator from Rumor through Operation." Journal of Environmental Economics and Management 28: 241-255.

Kohlhase, J. (1991). "The Impact of Toxic Waste Sites on Housing Values." Journal of Urban Economics 30(1): 1-26.

Lindell, M. K., T. C. Earle, et al. (1978). Radioactive Waste: Public Attitudes Towards Disposal Facilities. Seattle, WA, Battelle Human Affairs Centers.

Mac Gregor, D., and P. Slovic (1993). Perceived Risks of Radioactive Waste Transport Through Oregon: Result of a Statewide Survey.

McClelland, G. H., W. D. Schulze, et al. (1990). "The Effect of Risk Beliefs on Property Values: A Case Study of a Hazardous Waste Site." Risk Analysis 10(4): 485-497.

McClusky, J., and G. C. Rausser (1999). Environmental Contamination, Risk Perceptions, and Property Values. Economic Analysis and Land Use Policy, Washington, DC.

McMurray, R. I., and D. Pierce (1992). Environmental Remediation and Eminent Domain. ALI-ABA Eminent Domain Seminar.

Mendelsohn, R. D. Hellerstein et al. (1992). "Measuring Hazardous Waste Damages with Panel Models." Journal of Environmental Economics and Management 22: 259-271.

Metz, W. C. and D. E. Clark (1997). "The Effect of Decisions About Spent Nuclear Fuel Storage on Residential Property Values." Risk Analysis 17(5): 571-582.

Miller, N. (1992). A Geographic Information System-Based Approach to the Effects of Nuclear Processing Plants on Surrounding Property Values: The Case of the Fernald Settlement Study. Cincinnati, OH, University of Cincinnati.

Mundy, B. (1992). "The Impact of Hazardous Materials on Property Value." The Appraisal Journal 60(April): 155-162.

Mushkatel, A. H., J. M. Nigg, et al. (1993). Nevada Urban Residents' Attitudes Toward a Nuclear Waste Repository. Public Reaction to Nuclear Waste: Citizens' Views for Repository Siting. R. E. Dunlap, M. E. Kraft, and E. A. Rosa. Durham, SC, Duke University Press: 239-262.

Nelson, J. P. (1982). "Highway Noise and Property Values." Journal of Transport Economics and Policy: 117-138.

O'Riordan, T. (1986). Coping with Environmental Hazards. Geography, Resources, and Environment. R. W. Kates and I. Burton. Chicago, IL, The University of Chicago Press: 272-309.

Patchin, P. J. (1988). "Valuation of Contaminated Property." The Appraisal Journal: 7-16.

Patchin, P. J. (1991). "Contaminated Properties: Stigma Revisited." The Appraisal Journal 59: 167-172.

Payne, B., S. Olashansky et al. (1987). "Effects on Property Values of Proximity to a Site Contaminated with Radioactive Waste." Natural Resources Journal.

Pijawka, K. D. (1998). "Environmental Equity in Central Cities: Socio-Economic Dimensions and Planning Strategies." Journal of Planning Education and Research 18: 113-123.

Pijawka, K. D., and O. O. Ibitayo (1999). "Reversing NIMBY: An Assessment of State Strategies for Siting Hazardous Waste Facilities." Environment and Planning C: Government and Policy 17: 379-389.

Reichert, A. K. (1997). "Impact of Toxic Waste Superfund Site on Property Values." The Appraisal Journal (October): 381-392.

Smolen, G. E., G. Moore, et al. (1992). "Hazardous Waste Landfill Impacts on Local Property Values." The Real Estate Appraiser 58(4): 4-11.

Stock, J. H. (1989). Non-Parametric Policy Analysis: An Application to Estimating Hazardous Waste Cleanup Benefits. Non-Parametric and Semi-Parametric Methods in Econometrics and Statistics. W. Barnett, J. Powell, and G. Tauchen. Cambridge, Cambridge University Press.

Tobin, G. A., and B. E. Montz (1997). Natural Hazards: Explanation and Integration. New York, NY, The Guilford Press.

Webb, J. R. (1980). "Nuclear Power Plants: Effects on Property Values." The Appraisal Journal (April): 230-235.

Zia Research Associates. (1990). Santa Fe Property Value Opinion Research Survey Regarding the WIPP Bypass. Albuquerque, NM: 60.

## **APPENDIX A – Clark County Residential Survey Methodology**

A survey of Clark County residents was conducted by telephone during the month of August 2000 (Cannon Center, UNLV 2000). The survey collected data on public perceptions of possible property value impacts resulting from the proposal to transport high-level nuclear waste through Clark County to the proposed repository at Yucca Mountain. The sample for the survey was designed to allow estimates for the non-institutionalized population of Clark County and the surrounding areas close to the proposed routes for the shipment of nuclear waste to Yucca Mountain. Residential households were sampled using standard Random Digit Dialing (RDD) methodology. A minimum of five callbacks was placed to each household.

512 interviews were conducted with Clark County residents. The sample was purchased from Survey Sampling, Inc., Fairfield, Connecticut. This sample allowed for the inclusion of all households with a telephone whether the number was listed or not. Residents of institutional housing, such as college dormitories, military barracks, or nursing homes were excluded. One person, 21 years or older, was then selected at random within the sample household to participate in the interview using the “last birthday” technique.

Assuming a 95% confidence interval, the sampling error for this survey is approximately  $\pm 4.5\%$ . A 95% confidence interval with a  $\pm 4.5\%$  sampling error means that in 95 of 100 samples like the one used here, the results should be no more than 4.5% above or below the results that would be obtained interviewing all eligible residents living in Clark County. Because of refusal to participate and other factors, estimates may

understate the extent to which survey results differ from true population values (UNLV, *Clark County Property Value Survey Report* August 2000).

The questionnaire was closely adapted from the *Santa Fe Property Values Opinion Research Regarding the WIPP Bypass Survey* (ZIA Research Associates 1990). The Cannon Center at the University of Nevada - Las Vegas administered the survey that was modified to be specific to Clark County and the proposed Yucca Mountain repository program. Special care was taken to avoid response and question order biases. Whenever necessary, questions were asked in random order (called rotation) to reduce survey bias. The interviews were conducted using Computer-Assisted Telephone Interviewing (CATI) using the UNLV Cannon Center's CATI system.



## **APPENDIX B – Clark County Residential Survey Instrument**

## **APPENDIX C – Appraisers and Lenders Survey Methodology**

## **C.1 Populations Analyzed**

Two questionnaires were developed. One was administered to real estate appraisers and the other to lenders (Appendix D: Appraisers and E: Lenders). The questionnaire design was comprised of three components. The first component had six questions that characterized the demographic traits of those surveyed and measured their level of experience with contaminated property. The second component of the questionnaires was designed to measure how property values would change for three types of properties (residential, commercial, and industrial) under three different transportation-event scenarios. In addition, respondents were asked to provide their assessments of property value impacts for each scenario and at varying distances (within one mile and between one-to-three miles) from a possible transportation route.

The second component provides a direct valuation of property values under the various scenarios based on the experience and training of the lenders and appraisers. The third component queried lenders and appraisers as to how they would adjust key lending terms such as risk premiums and loan-to-value ratios under the various scenarios.

## **C.2 Scenarios**

The State of Nevada's transportation expert developed the three transportation scenarios that were integrated into the survey instrument. The first two scenarios are based on the shipping campaign described in the USDOE's Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada (DEIS 1999, Volume 2, Appendix J, Table J, pg, J-1). The third scenario developed by the State of Nevada's transportation expert, describes a serious but plausible accident event. These scenarios are detailed in Appendix D and E.

### **C.3 Population**

#### **C.3.1 Bankers**

One of the populations surveyed included representatives from all of the Clark County banks, which provide mortgage loans on residential, commercial, industrial, and raw property in Clark County. These banks were identified through the yearly Las Vegas Chamber of Commerce Membership Directory and cross-referenced for completeness with the Yellow Pages of the Clark County phone book. 31 banks were initially identified. A screening interview with a representative of all 31 banks was conducted by phone in order to determine whether the bank provided mortgage loans for residential, commercial, industrial, or raw land. Thirteen banks were eliminated for not meeting the screening criteria. The 18 banks remaining comprised the bank population included in the study.

#### **C.3.2 Appraisers**

The populations targeted for the surveys also included all active Clark County certified appraisers that are members of the Appraisal Institute (MAIs and SRAs). A list of 38, certified appraisers was identified from the 1999 and 2000 membership lists provided by the Appraisal Institute. The Appraisal Institute is a nationally recognized organization that certifies both general and residential property appraisers. The Appraisal Institute data were utilized to determine the survey population not only because of the institute's certification, but because it offers courses on appraising environmentally contaminated properties. Nearly all of the appraisers interviewed either had experience in appraising contaminated properties or were comfortable in doing such appraisals. An initial screening phone call was made with the appraisers in order to determine whether all thirty-eight were still active in Clark County. This screening task revealed that 3 of the

appraisers were no longer working in Clark County. The remaining 35 appraisers would encompass the population that was surveyed.

#### **C.4 Implementation**

After the survey instrument was developed, it was pretested with five certified appraisers. As noted above, the entire population of Appraisal Institute certified appraisers in Clark County is 35. In order not to reduce the number of appraisers available to be surveyed, the pretest was conducted with three appraisers from Phoenix and two appraisers from Tucson, Arizona. The pretest did not indicate the need for any changes to the survey instrument. Subsequently, utilizing the targeted interview list of bankers and appraisers as described above, the survey was implemented using a combination of face-to-face and telephone interviews.

Of the 18 lenders contacted, 15 completed the survey and three refused resulting in a response rate of 83.33% (Table 19). Two of those who refused indicated that they were too busy to respond. The third declined to give a reason for the refusal. Of the thirty-five appraisers contacted, twenty-five completed surveys were obtained for a participation rate of 71.4%. The remaining ten either did not return repeated phone calls to schedule a survey interview or indicated that they were too busy to participate.

**Table 25 Populations of Lenders and Appraisers**

Population	Number Interviewed	Number Refused	Response Rate	TOTAL
Lenders	15	3	83.3%	18
Appraisers	25	10	71.4%	35
TOTAL	40	13	75.5%	53

#### **C.5 Limitations**

It is important to recognize that there are a few limitations inherent in this study. The principal limitation is based on the *uncertainty* related to the USDOE's program for shipping spent fuel. For example, there are uncertainties in projecting the number of shipments, the length of time for the shipments, the actual routes to be used, and the nature of possible risk events. This study was designed to reduce these uncertainties as much as possible, by grounding as many of the assumptions as possible in the USDOE's DEIS, and by utilizing existing studies for plausible and likely program events.

A second limitation is inherent in adopting a prospective approach. This study examines the *potential* for property value impacts in the *future*, and the researchers had to develop a study design that not only recognizes these limitations but also reduces them. Hence, the study does not result in an appraisal of current *or* future property values. Appraising properties includes an understanding of existing markets. The questions asked experts to *judge* the potential for property value impacts under certain future conditions. Therefore, the two professional groups surveyed in this study were limited in their answers because of the uncertainties of market reactions to nuclear waste and their own lack of experience with nuclear hazards.

Despite this limitation, the study is based on "key informants" from two professional groups—bank loan officers (lenders) and appraisers who were members of the National Appraisers Institute. Both groups have many years experience in assessing the real estate market in Clark County, evaluating property values, and knowing the impacts of environmental contamination on properties. The high response rate and the consistency of the responses between the two groups increase the credibility of the findings. Yet, the findings from this study are generalizable to only the Las Vegas area as reflected in the focus of the study and the location of the appraisers and lenders.

Another limitation to the research is the use of three distinct property types for evaluation by the lenders and appraisers. These three types of property do not represent the range of properties within each type or that exist in Clark County. No attempt is made to extrapolate from these properties to all land uses in the corridors, although some impact seems likely given the findings of this research. Finally, the study was focused on potential property value diminution within a one-to-three mile distance from the shipment routes. The results of the research should not be extrapolated, therefore to properties outside of the possible shipment corridors.

#### **C.6 Statistical Analysis**

The data were entered into the computer using Access 7.0 and SPSS 9.0 software. Descriptive statistics for all dependent and independent variables were analyzed including measures of location, spread and shape. The measures of location also known as central tendency studied included the mean, median, and mode. Measures of spread alternatively known as variability or dispersion that were examined included variance, standard deviation, range, inter-quartile range, and quartile deviation. These measures describe how the survey responses cluster or scatter in their distribution. Skewness and kurtosis, which are measurements of shape, were also calculated mathematically as well as graphically.

## Appendix D Appraisers Survey

Date: \_\_\_\_\_ Identification Number \_\_\_\_\_  
Interview Date & Time: \_\_\_\_\_ Initials \_\_\_\_\_

### Questionnaire: Appraisers Version

INTRODUCTION: Hello, I am, \_\_\_\_\_ we spoke on the phone about the survey of appraisers and lenders that we are conducting concerning the effect on property values of the U.S. Department of Energy's plan to transport radioactive waste through Clark County.

SCREEN: Just to confirm you are an appraiser in Clark County and have been working there for at least five years. If "yes" Continue. If "no" ask: "May I speak with someone in your firm who has five years experience?" Then, repeat the above and continue, if not available, thank, terminate, and tally.

To begin, I have a series of questions that focus on your experience

1. What types of properties do you appraise? (Please indicate all that apply.)

Residential \_\_\_\_ Commercial \_\_\_\_ Industrial \_\_\_\_ Raw Property \_\_\_\_ Casinos \_\_\_\_

2. How many years appraisal experience do you have in Clark County? \_\_\_\_\_

3. How many total years appraisal experience do you have? \_\_\_\_\_

4. Do you have experience appraising properties that are known or may be contaminated?

Yes \_\_\_\_ No \_\_\_\_

5. With regards to appraisals:

a. Who is responsible for informing the appraiser of the contamination?

---

b. Based on your experience, when a clean up is completed at a contaminated property in Clark County is their any residual property value loss attributable to the fact that at one time it was contaminated?

Yes \_\_\_\_ No \_\_\_\_ Sometimes \_\_\_\_

6. Are the following underwriting standards on loans adjusted when a property has a potential or an actual environmental problem?

	Yes	No
Loan-to-value-ratio		
Borrower indemnification		
Personal liability		
Interest rates		
Risk premium		
Amortization period		











## **Appendix E Lenders Survey**

Date: \_\_\_\_\_

Identification Number \_\_\_\_\_

Interview Date & Time: \_\_\_\_\_

Initials \_\_\_\_\_

### Questionnaire: Lenders Version

INTRODUCTION: Hello, I am \_\_\_\_\_, we spoke on the phone about the survey of appraisers and lenders that we are conducting concerning the effect on property values of the U.S. Department of Energy's plan to transport radioactive waste through Clark County.

SCREEN: Just to confirm you are a lender in Clark County and have been working there for at least five years. If "yes" Continue. If "no" ask: "May I speak with someone in your firm who has five years experience?" Then, repeat the above and continue, if not available, thank, terminate, and tally.

To begin, I have a series of questions that focus on your experience

1. For what types of properties does your institution provide loans? (Please indicate all that apply.)

Residential \_\_\_\_\_ Commercial \_\_\_\_\_ Industrial \_\_\_\_\_ Raw Property \_\_\_\_\_ Casinos \_\_\_\_\_

2. How many years lending experience do you have in Clark County? \_\_\_\_\_

3. How many total years lending experience do you have? \_\_\_\_\_

4a. Does your institution have a policy on lending on properties known to be contaminated?

Yes \_\_\_\_\_ No \_\_\_\_\_

b. If yes, can I get a copy of it, if it is a written policy? If not written, could you please summarize it?

---

5. With regards to appraisals:

a. If the presence of an environmental contaminant is indicated, do you ask your appraisers to consider the known contamination in the appraisal process? Yes \_\_\_\_\_ No \_\_\_\_\_ Sometimes \_\_\_\_\_

b. Who is responsible for informing the appraiser of the contamination? \_\_\_\_\_

c. Based on your experience, when a clean up is completed at a contaminated property in Clark County is there any residual property value loss attributable to the fact that at one time it was contaminated? Yes \_\_\_\_\_ No \_\_\_\_\_ Sometimes \_\_\_\_\_

6. Are the following underwriting standards on loans adjusted when a property has a potential or an actual environmental problem?

	Yes	No
Loan-to-value-ratio		
Borrower indemnification		
Personal liability		
Interest rates		
Risk premium		
Amortization period		















## Appendix F Clark County Residential Survey Tables

**Table 26 Residential Property Ownership Interest**

	Yes Percent (N)	No Percent (N)	Total Percent (N)
Ownership of residential property or home (Q# 9)*	61.3% (313)	38.7% (198)	100.0% (511)
Plans to buy residential property or additional home (Q# 10)*	31.8% (155)	68.2% (333)	100.0% (488)

\*These responses represent valid percentages. In Question #9 one respondent missed this question. In Question #10, 24 respondents did not answer.

**Table 27 Changes in Present Residential Property Values**

Believe that residential property values in Clark County, in general are:	Nevada Percent (N)	New Mexico Percent (N)*
Increasing	74.8% (383)	87.0%
Remaining the same	15.8% (81)	6.0%
Decreasing	2.1% (11)	1.0%
Not sure	7.0% (36)	6.0%
No answer**	0.2% (1)	NA
TOTAL	100.0% (512)	100.0% (501)

\* All percents are rounded to the nearest whole number and only total N was available for comparison.

\*\* Categories not used in the Santa Fe, New Mexico survey

**Table 28 Effects of Different Environmental Conditions on Perceived Residential Property Values Clark County, Nevada (NV) versus Santa Fe, New Mexico (NM)**

Environmental Condition	Increase Value		Not Affect Value		Decrease Value		Do Not Know/Refused	
	NV	NM	NV	NM	NV	NM	NV	NM
Public school	61.1%	61%	28.7%	30%	7.2%	5%	2.9%	4%
Shopping center	52.5%	50%	28.1%	22%	16.8%	22%	2.7%	6%
Day care center	42.2%	42%	42.6%	44%	11.3%	10%	3.9%	4%
Limited access highway	31.1%	30%	21.9%	23%	41.4%	40%	4.1%	7%
Amusement park	29.9%	25%	16.2%	26%	47.9%	44%	6.1%	5%
Casino or gaming property*	20.1%	NA	22.7%	NA	49.6%	NA	7.6%	NA
Horse racing track	11.1%	21%	14.3%	30%	68.8%	40%	5.7%	5%
Nonpolluting industry	10.5%	37%	21.7%	26%	64.8%	33%	2.9%	4%
Homeless shelter	5.1%	7%	17.2%	38%	73.6%	50%	4.1%	5%
Landfill	2.5%	6.4%	2.0%	11%	93.9%	80%	1.6%	3%
Highway/ freeway used to transport nuclear waste	1.8%	6.4%	9.0%	12%	86.3%	79%	2.9%	3%
Polluting industry	1.4%	5.8%	1.2%	3%	95.5%	89%	2.0%	2%

\* Not asked in the Santa Fe, New Mexico survey.

**Table 29 Effects of Different Environmental Conditions on Decreasing Residential Property Value**

Environmental Condition	Rank Order (Percent stating decreasing property values)	
	Nevada	New Mexico
Polluting manufacturing facility	95.5%	89%
Landfill and waste dumping site	93.9%	80%
Freeway used to ship nuclear waste	86.3%	79%

**Table 30 Net Environmental Impact Index Ratings Clark County, Nevada (NV) versus Santa Fe, New Mexico (NM) (ranked in order from positive to negative)**

Environmental Condition	Net Environmental Impact Index Rating	
	Nevada	New Mexico
Public school	+53.9	+ 56
Shopping center	+35.4	+28
Day care center	+30.9	+32
Amusement park	-18.0	-19
Casino or gaming property	-29.5	NA
Limited access highway	-41.0	-10
Nonpolluting industry	-54.3	+4
Horse racing track	-57.7	-19
Homeless shelter	-68.5	-43
Freeway used to ship nuclear waste	-84.5	-72
Landfill and waste dumping site	-91.4	-74
Polluting industry	-94.1	-83

**Table 31 Cross-Tabulation Between Persons Believing Property Values Will Decline and Other Explanatory Factors for Clark County, Nevada**

	Yes	No
Plans to buy residential property	90.2%	89.1%
Familiarity with Yucca Mountain	89.5%	86.6%
Familiarity with USDOE plan to ship nuclear waste	89.2%	88.3%

**Table 32 Familiarity with the Yucca Mountain Project and the USDOE's Plan to Ship Nuclear Waste Through Clark County**

	Yes Percent (N)	No Percent (N)	Not Sure Percent (N)	Refused Percent (N)	Total Percent (N)
Familiarity with Yucca Mountain	77.1% (395)	19.9% (102)	2.0% (5)	1.0% (10)	100.0% (512)
Familiarity with USDOE shipment plans	73.2% (375)	24.2% (124)	1.4% (7)	1.2% (6)	100% (512)

**Table 33 Distance from Proposed Shipment Route in Clark County, Nevada**

	Do You Live within 3 Miles of One of the Shipment Routes? Percent (N)	Do You Live within 1 Mile of One of the Shipment Routes? Percent (N)
Yes	78.6% (396)	40.6% (205)
No	19.0% (96)	56.0% (282)
No sure	2.0% (10)	3.0% (15)
No answer	0.4% (2)	0.4% (9)
Total	100.0% (504)	100.0% (504)

**Table 34 Distributions of Respondents' Residences by Proposed Routes in Clark County, Nevada**

Proposed Route	Percent (N)
Interstate 15	31.4% (133)
U.S. 95	53.2% (275)
State Route 160	0.9% (4)
Northern Beltway	6.6% (28)
Southern Beltway	7.8% (33)
Total	100.0% (423)

**Table 35 Sample Distributions by Length of Residency in Clark County, Nevada**



Residency in Years	Frequency	Percent (N)
Less than 3 years	93	18.2% (93)
3 but less than 5 years	85	16.6% (85)
5 but less than 15 years	136	26.6% (136)
15 but less than 25 years	80	15.7% (80)
More than 25 years	117	22.9% (117)
<b>TOTAL</b>	<b>511</b>	<b>100.0% (511)</b>

**Table 36 Sample Distributions by Age**

Age	Frequency	Percent
21-29	84	16.4
30-44	170	33.2
45-64	169	33.0
65 and older	79	15.4
Total Responding	502	98.0
Missing	10	2.0
<b>TOTAL</b>	<b>512</b>	<b>100.0</b>

**Table 37 Sample Distributions by Level of Education**

Level of Education	Percent (N)
--------------------	-------------

Some high school or less	6.4% (33)
High school graduate	26.0% (133)
Some college	20.7% (106)
2-year college degree	13.9% (71)
4-year college degree	19.1% (98)
Post graduate studies/degree	11.3% (58)
Total Responding	97.5% (499)
Missing	2.5% (13)
TOTAL	100.0% (512)

**Table 38 Sample Distributions by Race/Ethnic Group**

Race/Ethnicity	Percent
Caucasian/White	70.5% (361)
Black/African American	12.9% (66)
Hispanic	6.6% (34)
Asian American	3.9% (20)
Native American	2.0% (10)
Other	1.2% (6)
Total Responding	97.1% (497)
Missing	2.9% (15)
TOTAL	100.0% (512)

**Table 39 Sample Distributions by Household Income**

Household Income	Percent (N)
Less than \$15,000	8.0 % (41)
>15,000 - \$25,000	9.4% (48)
> 25,000 - \$40,000	23.2% (119)
> 40,000 - \$70,000	27.9% (143)
> 70,000 - \$100,000	13.1% (67)
More than \$100,000	7.6% (39)
Total Responding	89.3% (467)
Missing	10.7% (55)
TOTAL	100.0% (512)

**Table 40 Sample Distributions by Gender**

Gender	Percent
Male	45.7% (234)
Female	52.5% (269)
Total Responding	98.2% (503)
Missing	1.8% (9)
TOTAL	100.0% (512)

**Table 41 Sample Distributions by Clark County Homeownership.**

Ownership	Percent (N)
Yes	61.1% (313)
No	38.7% (198)
Total Responding	99.8% (511)
Missing	0.2% (1)
TOTAL	100.0% (512)

**Table 42 Sample Distributions by Clark County, Nevada Residency**

Residency	Percent (N)
Yes	97.7% (500)
No	2.1% (11)
Total Responding	99.8% (511)
Missing	0.2% (1)
TOTAL	100.0% (512)

**Table 43 Sample Distributions by Residential Locations**

Area of Residency	Percent (N)
Las Vegas	47.3% (242)
North Las Vegas	15.4% (79)
Henderson	12.3% (63)
Boulder City	0.4% (2)
Unincorporated Clark County	5.9% (30)
Summerlin	10.7% (55)
Green Valley	6.6% (34)
Total Responding	98.6 % (505)
Missing	1.4% (7)
TOTAL	100.0% (512)

**Table 44 Sample Distributions by Distance of One to Three Miles of the Proposed Transportation Routes**

Proposed Routes	Percent
Interstate 15	26.0% (133)
U.S. 95	43.9% (225)
State Route 160	0.8% (4)
Northern Beltway	5.5% (281)
Southern Beltway	6.4% (33)
Total Responding	82.6% (423)
Missing	17.4% (89)
TOTAL	100.00% (512)

**Table 45 Sample Distributions by Distance from Proposed HLNW-SNF Shipment Routes.**

<b>Distance from Shipment Routes</b>	<b>Percent (N)</b>
<b>More than 3 miles</b>	<b>18.0% (92)</b>
<b>Within 1 mile</b>	<b>40.0% (205)</b>
<b>Within 3 miles</b>	<b>38.3% (196)</b>
<b>Total Respondents</b>	<b>96.3% (493)</b>
<b>Missing</b>	<b>3.7% (19)</b>
<b>TOTAL</b>	<b>100.0% (512)</b>

## Appendix G Lenders and Appraisers Tables

**Table 46 Professional Experiences of the Lenders and Appraisers Surveyed**

Experience	Average Years of Clark County Experience	Average Years of Total Experience
Lenders	10.4	17.1
Appraisers	14.3	19.9
Std. Dev.	2.8	2.0

**Table 47 Lending Terms on Environmentally Contaminated Properties**

Lending Terms	Lenders	Appraisers
LTVR*	60.0%	57.1%
Borrower Indemnification	13.3%	42.9%
Personal Liability	20.0%	35.7%
Interest Rate	66.7%	46.7%
Risk Premium	53.3%	53.3%
Amortization Period	20.0%	13.3%

\*Loan-to-value-ratio